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# Quarterly Report

August 1 - October 31, 1970

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*"Useful Technology at your Fingertips"*

# Wesrac

WESTERN RESEARCH APPLICATION CENTER

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION / UNIVERSITY OF SOUTHERN CALIFORNIA  
LOS ANGELES, CALIFORNIA 90007

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WESRAC

Western Research Application Center

THIRD QUARTERLY REPORT

Period Ending October 31, 1970

Contract No. NASW - 1869

(February 1, 1970 - January 31, 1971)

WESTERN RESEARCH APPLICATION CENTER

Graduate School of Business Administration  
University of Southern California  
Los Angeles, California 90007

## HIGHLIGHTS

### 1. WESRAC Film

A full color, sound WESRAC film has been completed, and is being used successfully in WESRAC presentations.

### 2. California Environmental Health Association Symposium

On October 22, WESRAC participated in the California Environmental Health Association's Educational Symposium, with 2000 people in attendance. Approximately 200 participants observed WESRAC presentations at the WESRAC exhibit.

### 3. "Sales Results"

The number of active annual WESRAC clients at the end of the quarter was 58.

### 4. Engineering and Scientific Applications Operations

89 Retrospective Searches were performed and 21 Current Awareness Searches were in progress during this quarter.

### 5. Document Orders

An unusual number of abstract and citation references given to clients were considered by the requestor to be so pertinent that full documents were ordered. 28% is the highest figure in WESRAC history, and indicates a heightened quality of service.

### 6. DATA PAK and Index of WESRAC Searches

Two new indices have been completed during the quarter: The DATA PAK and the Index of WESRAC Searches. DATA PAK is a cross-reference of Key Words and their corresponding Citations, and a Subject

6. DATA PAK and Index of WESRAC Searches (Cont'd.)

Authority List Index. The Index of WESRAC Searches lists all previous searches according to the field of interest. These two indices combine to aid in stronger and more direct search strategies.

7. World Wide Publicity from Mercury Pollution Search

A public service search initiated by WESRAC in the mercury pollution area resulted in publicity which was copied in world-wide publications.



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## I

INTRODUCTION

This report covers activities of the Western Research Application Center for the third quarter period 1 August - 31 October, 1970. WESRAC is a Regional Dissemination Center for the NASA technology collection and other approved sources. The report is prepared in accordance with requirements of Article XV, Paragraph A5, National Aeronautics and Space Administration Contract No. NASW - 1869 for the year beginning February 1, 1970.

WESRAC is organized at the University of Southern California, Los Angeles, as part of the Graduate School of Business Administration under the administration and financial control of the USC Research Institute for Business and Economics.

## II

PHYSICAL PLANT, EQUIPMENT AND PERSONNELA. Physical Plant

The center continues to operate in two remodeled former residences and to use the IBM 360-30 computer located in the University Business School. These arrangements are adequate for current operations and for those predictable in the immediate future.

B. Equipment

No new major equipment was acquired during the period covered by this report.

C. Personnel

The following indicates WESRAC personnel by department at the end of the third quarter:

<u>Department</u>	<u>Full-time</u>	<u>Part-time</u>
Administration	3	3
Marketing	4	2
Engineering & Scientific Applications	3	6
Information Systems	<u>7</u>	<u>4</u>
TOTAL	17	15



### III MARKETING

#### A. The WESRAC Product

Current Awareness and Retrospective Searches continue to be the basic literature search services offered by WESRAC. Although computer searching, based on carefully prepared custom strategies, constitutes the great bulk of service in both areas, manual searching is still offered to a client where this, because of the nature of the problem, is a better means of uncovering relevant data.

#### B. Merchandising, Promotion & Publicity

##### 1. Public Service and Internally Generated Searches

WESRAC has been aware of the problem of mercury pollution of fresh water for some time. A search was therefore internally generated to see if WESRAC could come up with any information which would be of help in solving this ecological problem. The search turned up one article of special interest: a method developed in Japan for the removal of mercurial compounds from fresh water which had been perfected in laboratory tests. The Los Angeles Times was contacted, and an article describing this find as well as WESRAC services in general, was carried in the Los Angeles Times--Washington Post Syndicate. The article was copied throughout the world in various newspapers, and approximately 50 calls or written requests for more information about WESRAC have resulted.

WESRAC became aware of a problem the University of California at Davis was having with disposing of chemical wastes produced in research laboratories. The Davis Campus

was contacted, and WESRAC initiated a Retrospective Search to try and find a solution to this ecological problem. The search turned up an article describing a piece of equipment which precisely fit the needs of the Davis Campus: it would dispose of a variety of chemical wastes through a varied temperature burning process, and produced no residue that would pollute the air. In addition to the inherent advantages of conducting such a public service search, WESRAC was able to introduce this search to one of the Contract Clients serviced by WESRAC.

During the quarter WESRAC also initiated an internally generated search of the files for information on data retrieval methods. WESRAC is now providing itself a monthly Current Awareness Search in this field so as to be fully informed on the "State of the art" of data retrieval.

## 2. WESRAC Film

The WESRAC film mentioned in previous reports has been completed. The film, which is about 15 minutes in length, is in full color. It is being reduced to 8 mm and will be used in cartridge form, thus enabling WESRAC to have continuous showings during conventions and exhibits, and expedient and convenient use during regular WESRAC presentations.

The film was designed to be primarily educational in nature. It has been shown on a number of occasions, and the general reaction has been that the film is quite informative and useful in educating prospective clients.

### 3. Promotional WESRAC Products

WESRAC has begun a promotional CAS program whereby, for a three month period WESRAC will conduct a complimentary CAS on every retrospective search performed. The results are given to the interested individual who originally requested the given retrospective search, and it is hoped that this program will encourage more users to continue CAS's on a pay basis.

With much the same goals in mind, a Promotional SIP Program was initiated with the fifth issue of the WESRAC Newsletter. Five carefully selected SIP's were offered, and interested people could obtain one of the five on a free, three month trial basis. 106 promotional SIP's are currently being provided to people who responded to the program, and this introduction to WESRAC services is expected to yield additional usage in coming quarters.

### 4. Personal Sales efforts

During this quarter, three service representatives devoted full time to calls on prospects and clients. 269 personal visits with clients and prospective clients and 564 telephone contacts to arrange appointments and to respond to inquiries were completed.

During this quarter one WESRAC representative made a sales trip to Northern California to call on clients and prospects in that area. He gave 12 WESRAC presentations, and secured one contract renewal. He also initiated the contact which later led to a new WESRAC Annual Contract Client.

## 5. Direct Mail Solicitation

Seven direct mail campaigns were conducted during this quarter. WESRAC Newsletters were sent to our computerized list of over 10,000 prospects and clients in August and September. Also, a reprint of a Los Angeles Times article regarding the WESRAC search on the disposal of mercury in fresh water was mailed to this list.

Specialized promotional letters were also sent to California City Managers, former recipients of support packages in the Technical Brief Program, producers of mercurial compounds, and patent attorneys in the Los Angeles area. These mailings are described in detail below.

- a. California City Managers--106 letters were sent to California City Managers, from which WESRAC received a 26% response of managers interested in the WESRAC program. This has provided a good medium for WESRAC service representatives to keep in contact with these managers, in order to acquaint them with the NASA program and additional information sources available at WESRAC.
- b. Technical Brief Program--109 letters were sent to people who had previously utilized the Technical Brief Program, and who had requested support packages. A 10+% response indicating interest in the WESRAC program followed, and to date one \$500 contract has resulted directly from this mailing.



- c. Producers of Mercury Compounds--Reprints of the article carried in the Los Angeles Times covering WESRAC's discovery of a method to remove mercury compounds from fresh water was sent, along with a letter describing WESRAC services to forty-two producers of mercury compounds. Responses were received from several firms indicating interest in this find as well as in WESRAC services generally. While no sales have yet resulted from this search, the favorable exposure received in the media as well as in direct contact with the above mentioned firms seemed well worth the effort expended.
- d. Los Angeles Patent Attorneys--A letter was sent to 17 Los Angeles Patent Attorneys describing WESRAC services. At the time this report was prepared, one response had been received from this mailing.

Copies of the two WESRAC Newsletters and the four promotional letters are included in Appendix A.

## 6. Publicity

### a. Newspaper and Magazine Articles

#### 1). Los Angeles Times--Washington Post

As mentioned above, the Los Angeles Times--Washington Post Syndicate ran an article describing a WESRAC find regarding the removal of mercury compounds from fresh water on August 30. Numerous reprints from all over the world have been reported to WESRAC, but no complete listing of them is possible.

- 2). Machine Design printed an article in its August 20 issue discussing the NASA Technology Utilization Program, in which WESRAC contributed a short article.
- 3). David Komoto, WESRAC's manager of Information Systems, wrote an article describing the computer system used by WESRAC. This article appeared in the August edition of Datamation.

The Los Angeles Times Article and reprints of the Machine Design and Datamation articles make up Appendix B.

b. Television and Radio Publicity

Free television and radio spots were again provided by local stations in Los Angeles. This type of coverage, since it must be very brief and is often scheduled at less than ideal times, has not generated the same positive response that can be obtained by publicity carried in pertinent business and professional organs.

c. Group Presentations

WESRAC representatives appeared before 3 civic and professional groups during the quarter to make presentations of the NASA Technology Dissemination program. The groups addressed and the numbers attending are listed below:

<u>Date</u>	<u>Group</u>	<u>Number Attending</u>
August 5	Xerox Corporation, Palo Alto	15
August 6	ESL, Inc., Sunnyvale	12
August 20	TRW Semiconductors	20

### C. Annual Client Retainer Requirements

Continuing the policy set in the second quarter, the minimum annual client retainer is \$500. Companies which can anticipate greater annual use will receive services at lower unit costs by depositing retainers of \$1,500. or \$5000. This discount amounts to 10% and 20% respectively. Firms depositing retainers of \$500. or more are considered Annual Contract Clients. Firms requesting individual searches are called Special Clients, and are provided services at 20% over Annual Contract Client charges.

### D. "Sales Results"

During the third quarter, WESRAC added seven (7) new Annual Contract Clients. In addition, individual searches and services were paid for by 56 other businesses and organizations. Two of these came to WESRAC through the Small Business Administration Program.

The number of Annual Contract Clients at the end of the quarter was 58.

### E. Participation in the California Environmental Health Association Symposium

On October 22, WESRAC participated in the California Environmental Health Association's Educational Symposium. Approximately 2000 people attended this meeting, and WESRAC presentations were given to about 200 people who visited the WESRAC exhibit. WESRAC has received written requests for information from about 30 participants in this Symposium, and we expect the favorable exposure gained through our participation to lead to further WESRAC use during the next quarter.

#### IV ENGINEERING AND SCIENTIFIC APPLICATIONS

##### A. Operations

A total of 89 retrospective searches were requested and processed from August 1 through October 31. The average turn around time (period from receipt of search request to mailing of completed WESRAC report) has remained at 7 days. Minimum time for completion of a report remained at one day, and maximum turn around time was lowered to 13 days.

Utilization by clients of customized Current Awareness Searches has grown: 21 CAS's were being provided to Annual Contract Clients at the end of the quarter.

In order to meet the growing requests for WESRAC services, a full-time Ph.D. in chemistry has been added to the Engineering and Scientific Applications Staff.

##### B. Search Index

All retrospective searches conducted (approximately 750 to date) have been multiple indexed, key punched, and a printout made. The resulting "Index of WESRAC Retrospective Search Titles" has become an invaluable tool for easily determining what similar searches have been previously conducted as a first step by our Engineering Specialist before proceeding with a profile preparation for a new search request. Such a procedure will inevitably result in stronger, more thorough search strategies.



### C. Follow Up Procedure

The follow up procedure, which is essentially a tickler system that ensures routine contacts with recipients of search reports by the assigned specialist, has shown good results. General response has been positive, with a preponderance of favorable replies regarding the quality of WESRAC services.

WESRAC is beginning to coordinate the tickler system with the Marketing Department in hopes of demonstrating WESRAC's concern with client satisfaction and in hopes of promoting further usage of WESRAC services.

## V

INFORMATION SYSTEMSA. Document and Report Production

Abstracts and citations generated by WESRAC searches during the quarter numbered 3,139. Document production almost doubled during this quarter: 844 documents were provided to recipients of WESRAC services.

B. Computer Operations

The Pre-Search Routine for the Scientific Technical Information Modules 360 tape is now complete. As soon as WESRAC receives the first STIM's tape, we will develop linear search programs and an update tape program. The Systems Development Branch of the NASA Technology Utilization Division is cooperating in this project by helping WESRAC obtain a sample STIM's tape.

WESRAC is also in the process of creating an Index Sequential File for a segment of the NASA tape and its On-Line Random Retrieval System.

C. WESRAC Computer Index--Data Pak

The WESRAC Search Index, Data Pak, includes a cross-reference listing of Key Words and their corresponding citations and a Subject Authority List indexed to a single subject. The total cross-referencing characteristic of the Data Pak insures rapid location of pertinent data in computer searches.

## APPENDIX A

1. WESRAC Newsletter, Volume I, No. IV
2. WESRAC Newsletter, Volume I, No. V
3. WESRAC promotional letter to California City Managers
4. WESRAC promotional letter to users of Technical Brief Program
5. WESRAC promotional letter to producers of Mercury compounds.
6. WESRAC promotional letter to Los Angeles Patent Attorneys



# WESRAC NEWSLETTER



WESTERN RESEARCH APPLICATION CENTER

Graduate School of Business Administration University of Southern California  
809 West 34th Street Los Angeles, California 90007 (213) 746-6132 TWX 910-321-2981

VOL. I, No. IV

AUGUST, 1970

## Technology Terms Worth Knowing

### Number of References in WESRAC Data Banks

Sputtering	720
Somatology	37
Stereochemistry	211
Asynchronous Computer	86
Occult	305
Heuristic	118
Algorithmic	3536

(see last page for definitions)

●

**FLUIDICS:** the use of interaction of fluid stream, air/gas or /liquid, to perform many functions of instrumentation and information processing, without the use of moving parts and under the adverse conditions encountered in rigorous environments - the name comes from a contraction of fluid and logic.

Western Research Application Center at the University of Southern California in cooperation with the NASA and the Small Business Administration sponsored the first Fluidic Seminar and Workshop in Southern California at a two-day session, June 11th and 12th, 1970, at U.S.C.. Eighty-five scientists and engineers participated.

A. K. Oulie, WESRAC Director, and Jack Lang, Technical Utilization Officer of Small Business Administration, coordinated the planning to provide management and supervisors of production with the theory of Fluid Logic Control Systems, and to demonstrate the latest advances in Fluid Logic Hardware.

Co-sponsors included the American Institute of Aeronautics and Astronautics, Fluid Power Society of Southern California, Instrument Society of America, Society of Aerospace Materials and Process Engineers, and Society of Manufacturing Engineers.

Seaver Hall, the recently opened science building at U.S.C., was the scene of the second meeting day. There were nine separate rooms provided for manufacturing sponsors to demonstrate the latest production model machines available in Fluid Logic Hardware. All displays were operational, affording those present the opportunity to see the equipment functioning. Significant advances in the field of Fluid Logics in the past year were evident.

## Human Simulators to Test Safety Devices

Recent tests conducted by automobile manufacturers indicate that safety features proposed by the Federal government for 1971 models may not be as effective as anticipated.

Numerous government agencies, and manufacturers involved in all phases of automobile production are carefully watching the developments in setting safety standards. Once standards have been set, the impact on thousands of manufacturers will be almost immediate.

WESRAC has recently completed in-depth probes of its data banks for a large research organization concerning automobile safety. Two of the searches were entitled "Safety Features in Automobile Components" and "Human Simulators." These two searches alone yielded 181 accessible documents about auto safety containing over 8215 pages of pertinent material. Topics ranged from the "seat-belt syndrome" to the "Dynamic Photoelastic Stress Patterns from a Simplified Model of a Head."

Although a majority of the research was done in the United States, a great many of the documents came from foreign countries including Russia, France, Luxembourg, England, Australia, West Germany, Sweden, Bulgaria, Italy, Czechoslovakia, Japan and Spain.

*WESRAC has access to all this recorded research. For more information write to WESRAC, or call (213) 746-6132.*



## WESRAC'S Information Systems Manager Publishes

Mr. David T. Komoto, manager of the Information Systems at WESRAC, has just received notice of the publication date for a paper that he has written. His article, entitled "Data Management and Search Techniques for a Mass Technology Retrieval System", will appear in the August 1, 1970 issue of "Datamation", the computer technology magazine published by F. D. Thompson Publications, Pasadena, California.

## Retrieval Microfiche Systems Search

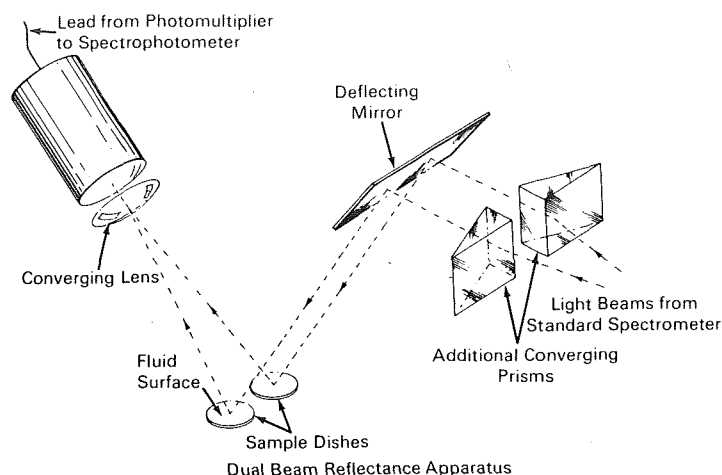
Recently WESRAC completed a search concerning a retrieval microfilm system. The problem stated was to "Identify and produce reference literature on information storage and retrieval microfilm systems."

The computer print-out yielded hundreds of abstracts. After final selection of relevant documents, our engineers ended up with some 36 reports containing over 2500 pages of pertinent information. These reports came from the U.S., Canada, Russia and Germany.

WESRAC not only has access to this wealth of technology on microfilm storage systems, but access to over two million documents on every facet of Science and Technology.

The WESRAC NEWSLETTER, issued every six to eight weeks by the Western Research Application Center at USC, is intended to provide current information relating to WESRAC's activities and special events concerned with utilization of new technology. We encourage contributions from our readers of articles which may be of interest to WESRAC and the rest of our reading audience. Send any contributions to: WESRAC, 809 West 34th Street, Los Angeles, California 90007.

## Discrimination of Fish Oil and Mineral Oil Slicks On Sea Water



J. MacDowall of Barringer Research, Ltd., under contract to NASA Headquarters, conducted laboratory and field investigations to determine the feasibility of distinguishing between fish oil and mineral oil slicks on sea water.

MacDowall ascertained that the oil slicks could be discriminated by their different spreading characteristics and by their reflectives and color variations over a range of wave lengths.

Laboratory experiments were conducted on the spreading characteristics of various oils on the surface of both calm and agitated sea water. A dual beam reflectance apparatus calculated the reflectivities of oil and oil films.

### FLORIDA COAST FIELD TEST

During a field trip investigation to the west coast of Florida, air and sea craft were used to correlate photographs of various slicks and the presence of schools of fish in the area.

MacDowall concluded that mineral oil slicks are easily recognized by their stability and high reflectivity and color variation whereas fish oil slicks are visible only by virtue of their calming effect on the surface.

## SATELLITE TO CHECK RELATIVITY THEORY

From 250 million miles out in space, two spacecrafts, Mariners 6 & 7, which flew by Mars last summer, are giving scientists a rare chance to check Albert Einstein's theory of relativity.

The present experiment, "A Fourth Test of General Relativity," was first proposed by Dr. Duane O. Muhleman of the California Institute of Technology and Dr. Irwin Shapiro of the Massachusetts Institute of Technology.

If one can measure precisely the time it takes for a radio signal to travel to a planet or spacecraft and back to Earth, the various theories of gravitation can be tested. In Einstein's theory, the velocity of light is slower in the gravitational field near the Sun than in interplanetary space where gravitational fields are weaker. Thus, as the radio signal passes near the Sun, the waves are slightly slowed and the total travel time is a little longer.

If Einstein's 54-year-old theory is correct, the slow-up in the round trip signal from JPL's Goldstone tracking station on the Mojave Desert will only be 200 millionths of a second, yet it can be

measured. Normal round trip time is about 45 minutes for the radio signal traveling at the speed of light (186,000 miles per second).

Once in April and again in May, the two Mariners are swinging behind the Sun, just before which the radio signals will pass very close to the Sun before the signal is occulted (out of "sight"). This will give scientists a chance to verify if the signal is slowed up by as much as two-tenths of a mile per second.

The radio astronomers hope, by analysis of the Mariner signals, to learn whether Einstein was right when he proposed his gravitational theory, or whether more recent observations which indicate Einstein's predictions could be in error by as much as 10 per cent are correct. Resolving any doubts about it is "of enormous importance to physicists and astronomers . . . because of the fundamental importance of gravity to a better understanding of the universe."

*The Mariner program is managed by NASA's Office of Space Science and Applications, and technological data generated through this and other NASA programs is available in WESRAC data banks.*

## WESRAC COMPUTERIZED TECHNICAL SOURCES:

Computerized Data Banks	Source & Kind of Information	No. Documents on Tape		Service Time	
		Total To Date	Monthly Increase	Current Awareness Search	Retrospective Search
NASA	NASA Reports; Selected DOD, AEC & other Gov't. Reports; Selected Reports from 1000+ Domestic & Foreign Technical Journals monitored regularly (Includes "STAR" & "AIAA").	500,000+	6,000+	Each Month	3-10 Days
Dept. of Defense (DDC-Bank)	All DOD Reports & many from other Gov't. agencies.	100,000+	3,000	Each Month	3-10 Days
Engineering Index	3500 Publications & Journals reviewed regularly. Material covers ALL Engineering Disciplines.	50,000	6,000	Each Month	3-10 Days
Chemical Abstracts	12,000 Journals & Publications reviewed regularly.	300,000	20,000	Semi-Monthly	10-12 Days
Index Medicus	2300 Worldwide Biomedical Journals reviewed regularly.	950,000	16,000	—	3-5 Weeks
Institute of Textile Technology	Natural & Synthetic fibers & textile processing (practical applications).	40,000	1,000	Each Month	3-10 Days
Educational Resources Info. Center (ERIC)	Journals & Report Literature cover fields of Education, Psychology, Sociology & Home Economics (Sponsored by Dept. Health, Education & Welfare).	35,000	6,000 Semi-annually	—	3-10 Days

## ADDITIONAL DATA SOURCES:

- More than 700 NASA, DOD and AEC Developed computer programs (complete with documentation).
- Manual searches of ANY source of technological data.

WESTERN RESEARCH APPLICATION CENTER  
Graduate School of Business Administration University of Southern California  
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WESRAC



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## Technology Terms Worth Knowing

(See page 1)



**SPUTTERING:** dislocation of the surface atoms of a material from bombardment by high-energy atomic particles.

**SOMATOLOGY:** the science concerned with the properties of organic bodies.

**STEREOCHEMISTRY:** Chemistry dealing with the arrangement of atoms and molecules in three dimensions.

**ASYNCHRONOUS COMPUTER:** a computer in which the performance of each operation starts as a result of a signal either that the previous operation has been completed, or that the parts of the computer required for the next quarter are now available.

**TO OCCULT:** In Astronomy, to hide or become hidden; as when one heavenly body disappears behind another.

**HEURISTIC:** Pertaining to exploratory methods of problem solving in which solutions are discovered by evaluation of the progress made toward the final result.

**ALGORITHMIC:** pertaining to a constructive calculating process usually assumed to lead to the solution of a problem in a finite number of steps.





# WESRAC NEWSLETTER



WESTERN RESEARCH APPLICATION CENTER

Graduate School of Business Administration University of Southern California

809 West 34th Street Los Angeles, California 90007 (213) 746-6132 TWX 910-321-2981

VOL. I, No. V

SEPTEMBER, 1970

## What are They Doing With It in Your Town?

WESRAC has just completed a most interesting search for the Environmental Control Office of the University of California at Davis. The chief of the department, Mr. Richard Holstock, recently appeared on a CBS-TV show in which he was criticized for open-fire burning of waste chemicals collected from all the chem labs on the huge campus. With chemicals gathered from the medical school and veterinary school, as well as all the undergraduate and graduate schools, the spectrum of wastes gathered spanned almost the complete atomic weight scale.

Mr. Holstock's problem was particularly difficult, because Davis is an isolated community with its own sewage disposal system; a system not large enough to provide the dilution capacity of even a small city's sewage disposal plant. So called "disposal" services could not give him satisfactory accounts of where or how they disposed of the toxic wastes. Under pressure from the community, to end the noxious odors of the burning chemicals, Mr. Holstock contacted WESRAC.

By means of a keyword concept search, WESRAC was able to find a direct reference to the subject. The abstract summarized a successful test experience with a commercially available piece of disposal apparatus. The hard document was obtained in a few days and the identity, and location of the authors of the document were made available. The Engineering Department of WESRAC, under the direction of Mr. Charles Dole, got in touch with the men and the firm where the original test had been made. The device used to destroy the waste chemicals, had been in operation for three years and had proved itself effective, after minor adaptations for certain waste products. With this confirmation, WESRAC prepared its report for U.C. Davis, including a description of the available machine. Mr. Holstock, the Environmental Control Officer, found it exceedingly helpful in redirecting his quest for a feasible method to destroy chemical wastes without polluting either the air, earth, or water in the Davis area.

After this search—one is prone to wonder what is being done with toxic chemical wastes in every large city in California. Are these toxic materials being quietly dumped into public sewage systems? Who knows exactly where or how the commercial disposal firms are getting rid of waste chemicals?

## WESRAC Film just Completed

WESRAC has just completed shooting its first film showing the services and scientific application opportunities which it offers.

The film, after describing the services of WESRAC, tells of the successes of several companies who used WESRAC's services to their advantages. These companies include Pneumetrics, Inc., Litton Industries and Scientific Drilling Corp. Also covered in the film are the step-by-step methods by which a search is completed for a client, from the client request all the way to the selection of the abstracts for the final report.

The film is to be used for sales promotion and for presentation at speaking engagements before industrial and scientific groups.



A still photo of two participants in the new WESRAC film now in preparation. Left: Mr. James Murray, Scientific Drilling; Right: Mr. A. Kendell Oulie, Director of WESRAC. They are discussing a revolutionary new oil drilling device made possible by WESRAC's data banks. A section of the film tells how Scientific Drilling used WESRAC.



## Possible Removal of Mercury Compounds from Water

Mercury compounds have been used extensively by paper mills and by the producers of seeds for the last 10-15 years to control the growth of bacteria and fungi. These microorganisms feed on the sugars produced by decomposition of cellulose (the main component of paper) and introduce stains and imperfections in the paper.

The mercury compounds most commonly used by the paper industry and seed growers are phenylmercuric acetate (PMA or "Merfenel") and ethylmercuric phosphate ("Lignasan"). These compounds are so poisonous that they are packaged in small paper envelopes that can be thrown into the water to avoid any contact between the operating personnel and the toxic material. Their high toxicity was recognized 10 years ago when the Federal Government set up restrictions prohibiting their use for papers which might come in contact with food products.

The mercury compounds are, however, used in small amounts (in the order of 1 oz./1000 gals.) and any mercurials that find their way to the sewer are further diluted. However, dilution, the old answer to pollution, does not work in the case of mercury. Federal tests have shown the presence of mercury in many streams and lakes; mercury compounds are not only insoluble, but when ingested by fish, become concentrated. The concentration factor from the water to pike is given as 3000 by *Science Magazine*. The careful worker that never touches the poisonous mercury compounds used in paper mills or by seed growers might be served the same compounds for dinner that very evening in a lethal concentration.

Men, like fish, can concentrate mercury in their bodies; this leads to chronic poisoning where bleeding, digestive disturbances, tremors, deafness and finally death occur.

WESRAC, interested in finding a solution to this dangerous problem, ran a search on the possible removal of mercury compounds from water. One Japanese document, in particular, seemed to offer the most promising solution. The Japanese researchers, (Drs. Suzuki, Furukawa, and Tonomura of the Fermentation Research Institute of Inage), discovered one of the contradictions of nature: there is a bacteria strain, "Pseudomonas K 62", which curiously enough was not killed by mercury compounds, and would actually thrive in their solutions, breaking up the compound chains into isolated groups, relatively easy to remove by known separation processes. These valiant bacterium, in 30 minutes, can break 90% of the mercury present in dilute solutions (5-10 parts per million,

approximately the same amounts found in mercury polluted waters). When the bacterium is transferred into a culture medium containing other nutrients, most of the cell-bound mercury is released in the form of volatile compounds, which are easily trapped by carbon filtration. The bacterial cells are now ready to absorb more mercury.

This process offers great promise for cleaning up mercury contaminated waters. Some developmental work, however, still needs to be done. Inorganic salts, such as sodium chloride, interfere with the mercury pick-up and therefore, at present, must be removed prior to treatment.

## Worth Knowing Technology Terms

doppler effect  
doghouse  
cyanometry  
astroballistics  
astrobiology  
erg  
stochastic  
virgin coil  
eponymous terms

## WESRAC Adds Another New Tape to It's Data Banks

The ERIC (Educational Resources Information Center) file, a new addition to the WESRAC Data Bank, is a project of the Department of Health, Education, and Welfare and contains about 35,000 computerized citations. It dates back to 1964 and was taken from the journal *Research in Education*, a monthly abstract journal published by the Office of Education, Bureau of Research. The ERIC file provides the most recent information about documents available in the field of educational research and is updated semiannually.

This collection presently contains only report literature, but it is expected that journal articles will be added in the near future. The ERIC file can be useful to researchers in the fields of education, sociology, psychology, and home economics.

The file is replete with educational trends; psychological, educational and vocational testing; home and school environment of students; curriculum research; teaching techniques; etc.



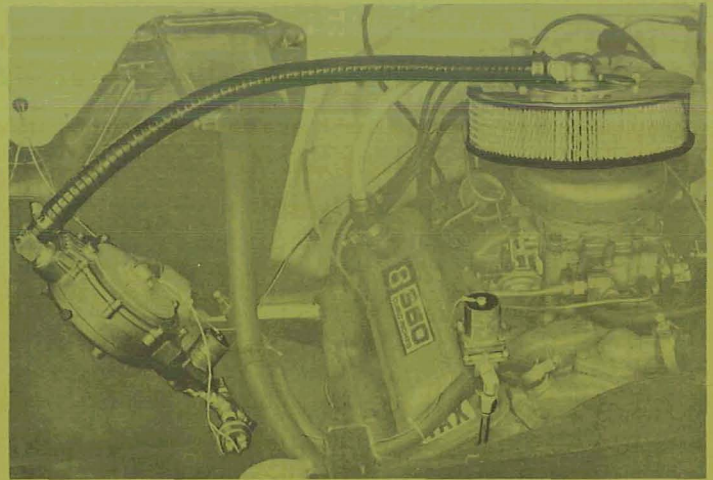
## Natural Gas to Replace Gasoline for Engines

Air-Dry-Pneumetrics, Inc. of Northridge, California, is giving full credit to WESRAC for conducting data searches which made it possible for the San Fernando Valley firm to win a contract, which has already yielded the company over a million and a half dollars in new business.

The firm had been specializing in supplying compressed air free of contaminants when the Defense Department beckoned with a tempting invitation to bid on a \$600,000 Navy order. Almost certain of landing this contract, Pneumetrics, was shocked to learn it had lost out to an Eastern manufacturer. A lot of money had been spent and the company could not wait for another big contract bid to appear. It had to move and move fast, but where?

Pneumetrics Inc., had learned that a giant California firm, which had undertaken to design and market a conversion kit to utilize compressed natural gas for automobiles, was having trouble with its test units icing-up and stopping the vehicles. The engineers at Northridge thought they knew the cause and approached the project-chief of the northern California kit-builder offering what they believed to be the needed correction. The chief listened, but dismissed their offer.

Out of this second defeat was born the idea of Pneumetrics competing with this firm in the manufacture of natural gas conversion kits for motor vehicles. However, there were two major obstacles to be hurdled in order to be in the running for bidding on a big order from the Federal agency charged with making pollution standard tests in all areas of the country. The first was that Pneumetrics could not afford to hire consultants in the many areas of knowledge in which they were lacking, particularly natural gas and carburetion. Also they couldn't afford to acquire the needed data by the old fashioned methods of manual search and study. It was at this point Pneumetrics got in touch with WESRAC. The strategies of the computer



*Pneumetrics' kit equipped car was entered in the C.I.T.-M.I.T. Anti-Pollution Cross Country Derby Aug. 25. The actual entry will be sponsored by the Atlanta Gas Lighting Co. of Atlanta which is testing the Pneumetrics conversion unit on a fleet of its cars.*

queries were set up and agreed upon, and the big 360 IBM machines began scanning the huge banks of technical data. From this search, Pneumetrics obtained within a matter of days, full text, hard copies of nine invaluable documents.

The contract for which Pneumetrics was bidding, was for conversion kits to be tested by the Federal Government to establish Federal standards for automobile pollution controls. From this study, Washington hopes to establish attainable standards upon which to base legislation and set compliance dates for the Detroit auto makers. In early June, Pneumetrics Inc. was awarded a contract for 250 units and several compressors. Since then, they have received over a million and a half dollars in firm orders.

In addition to freeing exhaust emissions of 90% of gasoline pollutants, natural gas-propelled vehicles require only a fraction of the maintenance needed by gasoline powered engines. To this can be added even greater savings which natural gas offers by extending the life of the ordinary vehicle to twice that of the gasoline powered car. No fouled plugs—no carbon deposits—no oil dilutions—are a few of the economies. And the cost? Natural gas would only run about  $\frac{1}{4}$  the cost of gasoline.



Phone WESSRAC at (213) 746-6132

Graduate School of Business Administration University of Southern California  
19 W. 24th Street Los Angeles, California 90007

WESSRAC RESEARCH APPLICATION CENTER

WESSRAC



Non-Profit Org.  
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PAID  
Permit No. 2075  
Los Angeles, Calif.

## Technology Terms Worth Knowing

**DOPPLER EFFECT:** The change in frequency with which energy reaches a receiver when the receiver and the energy sources are in motion relative to each other.

**DOGHOUSE:** Slang for a protuberance or blister that houses an instrument on an otherwise smooth skin of a rocket.

**CYANOMETRY:** The study and measurement of the blueness of the sky.

**ASTROBALLISTICS:** The study of the phenomena arising out of the motion of a solid through a gas at a speed high enough to cause ablation; for example, the interaction of a meteoroid with the atmosphere.

**ASTROBIOLOGY:** The study of living organisms on celestial bodies other than earth.

**ERG:** A unit of energy equal to one dyne of work operative through one centimeter of distance.

**STOCHASTIC:** A term that refers to trial-and-error procedures as contrasted with the fixed step-by-step procedures of algorithms.

**VIRGIN COIL:** Computer tape completely devoid of punches.

**EPONYMOUS TERMS:** Terms based on the name of the discoverer, innovator, or patron; examples: ampere, angstrom, ohm, volt, watt. A system largely abandoned in favor of Latin-Greek root origins



## WESTERN RESEARCH APPLICATION CENTER

*computerized access to world technology*

August 26, 1970

Name  
City Manager  
City Hall  
City, State

Dear Mr. \_\_\_\_\_:

You are probably aware of NASA's effort to put all its aerospace technology at the service of city managers and administrators. Many communities are utilizing this aerospace data by participating in the recent Information Pool Program jointly conducted by NASA and the International City Management Association.

Whether or not you are participating in this program, you should know that an even more comprehensive collection of NASA technology is available to you right here in California. It is available through the NASA funded Western Research Application Center (WESRAC) located in the Graduate School of Business Administration at the University of Southern California. Here, we have, in addition to all the NASA data, the up-dated banks from the Department of Defense, Atomic Energy Commission, Educational Resources Information Center, as well as the valuable Chemical Abstracts and Engineering Index, a total of over 1,000,000 documents which are being added to at a rate of 35,000 per month.

At WESRAC we also have qualified experts in a variety of fields of knowledge to facilitate your search for answers to the tough questions confronting city managers and administrators. Such critical areas as air-water pollution, traffic, parking, garbage disposal, chemical waste disposal, are a few of the 20,000 separate subjects covered by WESRAC's material. We are as close to you as the phone on your desk. A call or the return of the enclosed card will summon a WESRAC representative for you. You owe it to yourself as well as to the residents of your community to discover how WESRAC can help you solve your old problems with modern technology.

Sincerely,

A. Kendell Oulie  
Director

AKO:kjd  
Enclosure





## WESTERN RESEARCH APPLICATION CENTER

*computerized access to world technology*

August 26, 1970

XX  
XX  
XX  
XX

Dear Mr. XXX:

You may recall contacting the NASA Technology Utilization Division regarding the "Technical Briefs" program. Having used this service, you are aware of the value of current knowledge in a given area of interest.

NASA has established Regional Dissemination Centers such as WESRAC at the University of Southern California to more efficiently get technical information into the hands of industry. WESRAC now has the most comprehensive collection of technology indexed on computer, with over 1,000,000 documents covering more than 20,000 subject areas. We are adding about 50,000 reports a month. The use of this collection will help you

- get new ideas
- improve operations
- avoid duplication of work already done by others
- save time for your management and professional people.

In short, our qualified engineers and technical specialists can get specific answers to your specific questions faster.

If you have a problem or want to know more about any area of interest, call us, or return the enclosed card.

Sincerely,

A. Kendell Oulie  
Director

AKO:kjd  
Enclosure



## WESTERN RESEARCH APPLICATION CENTER

*computerized access to world technology*

September 18, 1970

Vice President, Engineering & Research

XXXXX

XXXXX

XXXXX

Dear Mr. \_\_\_\_\_

Western Research Application Center (WESRAC) is a NASA funded non-profit data bank and retrieval operation located at the University of Southern California. We conducted a special search on the subject of mercurial compounds contamination of fresh water and means of removal of the metal from dilute solutions.

Among the mass of material we uncovered was a Japanese report on a laboratory method of rectifying mercury pollution. The results of our search were reported by the Los Angeles Times-Washington Post Syndicate (we enclose a reprint). We are writing you because you are one of the producers of the organomercurials used by the paper and seed industries as slime inhibitors. A couple of random calls to Research Directors of major mercury compounds producers revealed no awareness of the existence of the Japanese report mentioned above. If you or the people under you do not know of this report and would like to have an English translation of the full document, we will be pleased to send it to you.

The facilities, staff, and university connections of WESRAC confer it a capacity for data retrieval that few private organizations could afford to mount or maintain. The data banks and their assemblage on tapes have been paid for by the Federal Government.

To use this 50 billion dollar collection of technology data, you pay for the cost of technology specialist and computer time only. Write, or call about the article attached, or for answers to questions from any of the 20,000 subject matters listed in our index.

Sincerely,

A. Kendell Oulie  
Director

AKO:kjd  
Enclosure



## WESTERN RESEARCH APPLICATION CENTER

*computerized access to world technology*

October 14, 1970

American and Foreign Patent Service  
1680 Vine Street  
Los Angeles, California

Dear Sirs:

We have had a number of inquiries from both patent attorneys and consultants asking to use our data banks and computer retrieval facilities for current and retrospective searches to determine the "State of the Art" over a broad spectrum of technologies.

WESRAC is pleased to announce that it can now provide this service with a capacity to search seven of the largest data banks in existence covering in excess of 20,000 subject areas. WESRAC can do this at a fraction of the cost you may be paying for searches by conventional, time consuming methods.

Western Research Application Center, at the University of Southern California, is a NASA and industry supported non-profit facility. The enormous expense of gathering, compiling, abstracting, translating and computerizing this data from thousands of journals from all over the world, including the Soviet Union and its satellite nations, has been paid for by our government. The cost to you to search these vast banks of data is for the time to computerize your question, the actual computer use, and, if desired, expert screening of the results to save you reading time.

WESRAC's capacity, backed by the combined capabilities of a great University, and its libraries, is currently serving many of the most technically advanced industries and laboratories in the west. We believe we can help you and your clients.

Call or write me and I will be glad to explain how WESRAC can work for you.

Sincerely,

A. Kendell Oulie  
Director

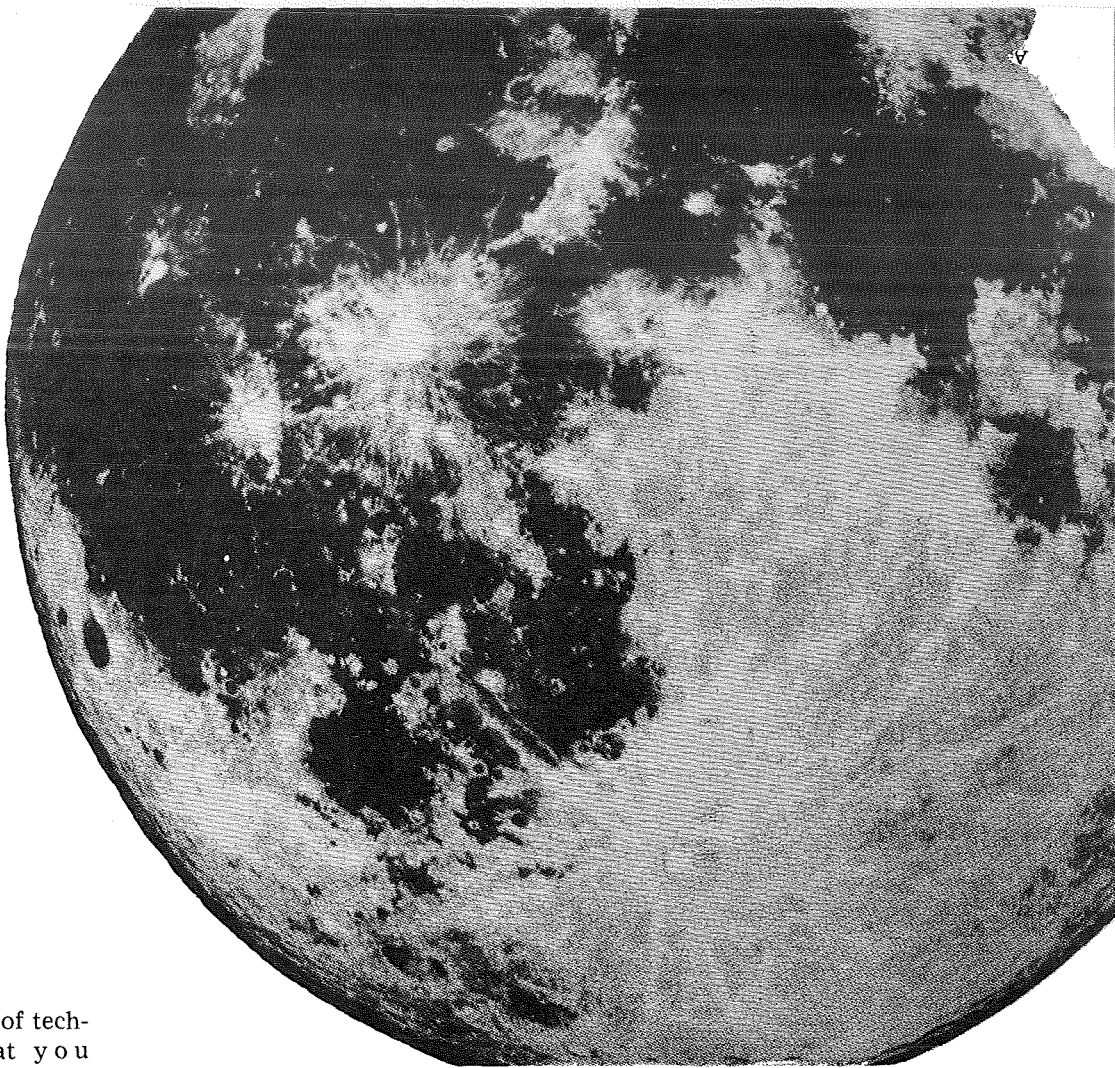
AKO:kjd

## APPENDIX B

1. WESRAC article in Machine Design
2. WESRAC article in Datamation
3. WESRAC article in the Los Angeles Times



# DESIGN FOR THE 70S



**ROBERT B. ARONSON**  
*Associate Editor*

LOOK over this big batch of technical goodies, take what you want, and go make a profit for yourself. This, essentially, is what NASA has been telling U. S. industry for six years through its Technology Utilization (TU) program. While not as dramatic as a moon landing, or as immediately useful as a weather satellite, TU offers a storehouse of potentially useful information for those who are able to dig for it. Through an extensive information dissemination program, TU is trying to increase the return on the \$35 billion that NASA programs have used in taxes.

The program to date can probably be termed a partial success. According to most surveys, it is paying its own way. Reports can identify about \$3 to 4 million per year in benefits to industry that have taken advantage of NASA information. That is about the cost of keeping the TU program going.

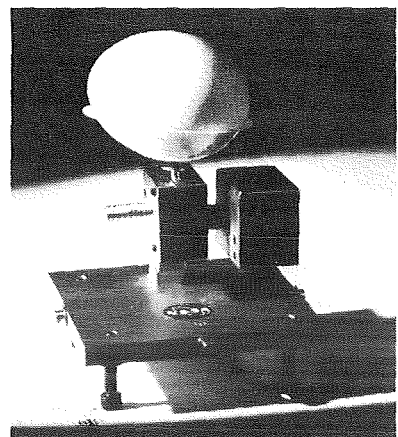
The TU budget for fiscal 1971 is \$4 million, which is  $\frac{1}{8}$  of 1% of NASA's entire budget. Of this figure, \$2.1 million are to be used for retrieving, evaluating, and publishing and \$1.9 for spe-

cial dissemination efforts. Congress recently authorized an additional half million to be used to filter out information that might help solve problems in such areas as housing, pollution, and crime.

## **How Does TU Work?**

The long path that gets a useful piece of technical information from a NASA program into the hands of an engineer in industry begins in the laboratories conference rooms and on the drawing boards of NASA's 12 installations and about 4,000 NASA contractors. Information

# ***The Moon and What Else for \$35 Billion?***



Sensor developed to detect micrometeoroid impacts has been adapted to detect minute heart tremors in humans.

## Comments from Washington

■ Since 1958 the National Aeronautics and Space Administration has been discovering new things about materials, machines, and human beings, as well as the earth, the Moon, and the universe. Mankind's gain would be slight if these many discoveries were not widely shared. From the beginning, therefore, the information and data acquired have been collected and made available to prospective users both within and outside the aerospace community.

The Office of Technology Utilization manages two integrated and complementary information programs using basically the same data base, but which are designed and packaged for two different user groups—one for the aerospace community in direct support of its research and development programs, the other for the public and private sectors in all disciplines for the benefit of man. The first, the scientific and technical information program, involves the vertical transfer of highly technical information to users of the same type as the producers. The second, the technology utilization program, is a specially constructed program to transfer technology horizontally, across disciplines, across regions, across the broad industrial, medical and academic communities.

NASA has pioneered in automating the storage, retrieval, and dissemination of aerospace information and

data. This computerized capability in an on-line real-time mode provides services and products to both the aerospace and nonaerospace users. NASA also relies heavily on the conventional methods of communication.

The Scientific and Technical Information Division publishes reports, monographs, studies and reviews of the research and development developed by or for NASA. These are announced and indexed in the Scientific and Technical Aerospace Reports (STAR), and are available to the technical community as printed documents or in the form of microfiche for minimizing cost and storage requirements.

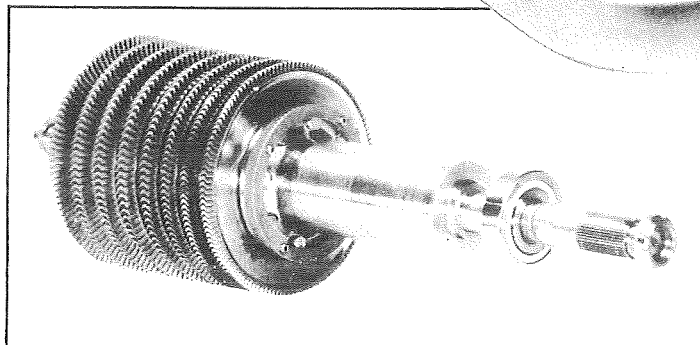
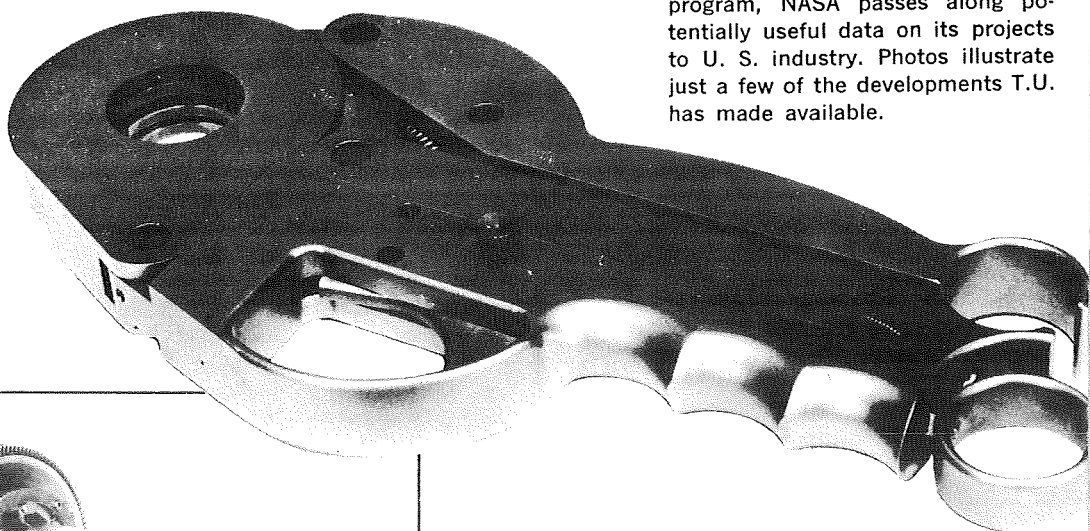
The Technology Utilization Division publishes for the non-aerospace community Tech Briefs, Technology Utilization Surveys, Technology Reports, Technology Handbooks, and Conference Proceedings.

As a research and development agency, NASA's major product is knowledge. By utilizing this new knowledge in nonaerospace efforts, the public gains an additional dividend on its aerospace investment. We are trying to place this new knowledge into the hands of the engineer, the designer, and the manager in a form of the greatest value and in time for it to be of maximum use to him.

**Melvin S. Day**

Acting Assistant Administrator  
for Technology Utilization

Through the Technology Utilization program, NASA passes along potentially useful data on its projects to U. S. industry. Photos illustrate just a few of the developments T.U. has made available.



Energy of .22 blank swages two tubes together creating a snug, vibration-resistant joint, above. Turbine rotor, left, is 8-in. long, 7-in. in diam and generates 12,000 hp at 47,800 rpm.

passes both formally and informally from the individual scientists and engineers to one of the NASA installations. Each TU office has a staff that is responsible for gathering and evaluating information in its own area. In addition, each NASA subdivision has someone assigned to look specifically for new technology and pass it along to the TU office. TU staff members also monitor all work reports as well as NASA patents and items submitted to the cost-saving program.

Useful innovations are screened by the local TU staff, then sent to NASA headquarters in Washington, D. C. for dissemination to industry. This is done in several ways.

A brief description of the item may be published as a Tech Brief. Approximately 50 Tech

Briefs in nine different categories are mailed to 8,000 individuals each month.

The item may also be a candidate for part of the NASA special series of technical reports, which are compilations of information on a specific subject.

All scientific and technical reports accumulated by NASA are published in STAR (Scientific and Technical Aerospace Report) or IAA (International Aerospace Abstracts). Computer programs are published in CPA (Computer Program Abstracts). These three publications are abstract journals sold on a subscription basis.

Whatever their published form, all documents are abstracted and sent to the six regional dissemination centers. Through computer storage, each center has access to over 750,-

000 documents with approximately 6,000 added each month. To utilize a center's services, a client pays a service charge for each search made. This might be a single search for information on a specific subject, costing \$200, or a series of periodic searches on a certain area of interest, costing up to \$5,000 or more.

Realizing that industry can best understand what NASA has available through face-to-face contact, national and regional TU groups hold periodic seminars on topics of interest to a particular industry or section of the economy.

Researchers with specific questions may, under some circumstances, visit various installations and discuss their problems with NASA personnel.

Another effective way of get-

## The Word from NASA Headquarters

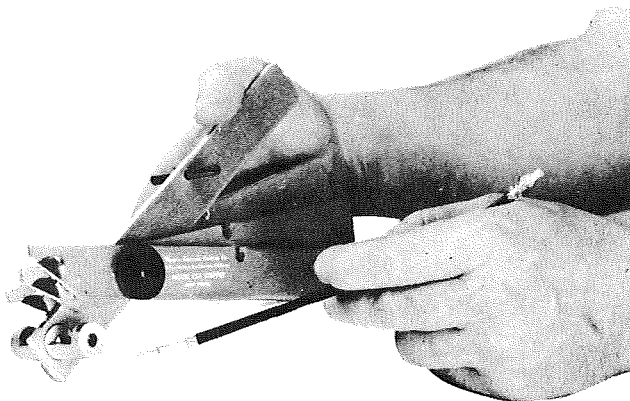
■ NASA has a mandate to provide for the widest practicable dissemination of information for the benefit of mankind. The NASA Technology Utilization Program is specifically attempting to shorten the timegap between the development of new technology and its application to the nonaerospace economy. Experimental programs which may be tapped by those outside of the space program range from announcements of specific, especially promising new technology (NASA Tech Briefs) and special publications such as Technology Utilization Surveys covering NASA contributions to entire areas of technology—to more dynamic problem solving and customer service programs such as NASA Technology Applications Teams and Regional Dissemination Centers.

The technology which results from aerospace activities is often sophisticated, yet it is of such a nature that it can be profitably exploited in the commercial market. To improve our mechanisms for identification of applicable technology and for encouraging its actual application elsewhere, NASA has also established a program to validate reports of actual application and transfer.

More technology already developed in the U. S. space program remains to be similarly applied by those individuals and firms aggressive enough to capitalize on this resource. These include complex electronics, machining and metalworking techniques, computer-aided design and manufacturing processes and much more.

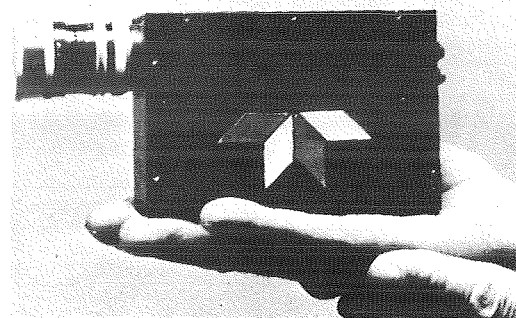
We encourage your participation.

**Ronald J. Philips**  
Director, Technology Utilization Division



Coaxial wire stripper is one of the simpler NASA products to find commercial application.

Miniature TV camera with 1½ in. by 6 in. vidicon tube developed for use in space vehicles is now available for industrial monitoring systems.





ting information transfer on a personal basis is BAT (Biomedical Application Team) and TAT (Technology Application Team). Three BAT's have been functioning for about three years. They are composed of people with engineering and medical training who work with medical researchers and try to solve individual problems with aerospace technology. This personalized attention makes for a clearer understanding of a problem and therefore more chance the answer will be found somewhere in NASA's data.

One TAT which has been around for about one year is taking the same approach to social and urban problems, such as crime, housing, and pollution.

### How Good Is It?

The supply of technical information exists as does the demand. The bottleneck is the transfer process. How can the nuggets of generally useful information best be panned from the vast quantity of aerospace

related information? NASA would like to know the answer too, and it has instituted a program of self-evaluation. In addition to its own internal monitoring system, NASA has hired Denver Research Institute to do a series of studies on various aspects of the TU program. The Institute's analyses have pointed up a number of problems that have led to improvements.

Unfortunately, a precise evaluation of how well the TU programs are functioning is not possible. DRI researchers found that many companies can not pinpoint where an idea first originated. Many companies are reluctant to admit they are utilizing NASA data for competitive reasons. Or, will not admit they did not think of an idea themselves. In addition, there is little incentive to report sources of information.

### What's Wrong With TU?

Critics, informed and otherwise, have listed a number of complaints about the TU pro-

gram. Possibly valid are these:

It is sometimes not worth the effort to conduct an extensive investigation of NASA data in the hope of finding the useful information.

NASA has not spent enough effort in encouraging those that do the basic research to think in terms of commercial application for their respective projects.

There is a rather long lead time before the data on a NASA project is available to industry. A company picking up a NASA idea therefore runs a risk that their competition already has done work on the subject.

Many NASA projects are "lost in the laboratory" or in a snowstorm of paperwork and never come to the attention of the TU system.

On the business side of the problem, industry is usually not highly motivated to find answers to their problems through a TU program.

There is a reluctance to touch something that is not patent protected. Many NASA items involve ideas that are not patent-

## T.U. at Lewis Research

■ The Technology Utilization Office at the NASA Lewis Research Center is representative of NASA Field Center activities in the NASA Technology Utilization Program. We: (1) monitor, for new technology, the research and development work going on both at the Lewis Research Center and under contracts let by Lewis, (2) evaluate the new technology resulting from this R&D work, and (3) disseminate all new technology which has particular potential for applications beyond its original purposes.

To perform these functions, we have a staff of six professional people chosen for their broad and varied experience both in aerospace R&D and in industry, and for their diversity in scientific, technical and business education. Together, they monitor the ongoing R&D of some 2000 scientists, engineers and technicians in-house at the Lewis Research Center, and the R&D being carried out under some 350 contracts between Lewis and approximately 200 industrial firms, private research institutes and universities. In support of our professional Technology Utilization Office Staff, New Technology Representatives are designated by each of the twenty-three Lewis in-house scientific and technical Divisions and also by each of the Lewis technical contractors. These New Technology Representatives assist us by helping to identify new technology developed in their particular areas.

The Lewis Technology Utilization Office is continually

exploring additional ways of bringing the existence, availability and usefulness of NASA technology to public attention. We have in the last six years organized and held conferences on selected pertinent technology for the petroleum industry, the electric power industry, small businesses, and a broad audience of industrialists in our own geographic area. We supply appropriate speakers and exhibits for both professional and non-professional meetings. We actively support the publication of articles in professional, technical and trade journals, and contribute to television and radio programs.

Although much of the new technology resulting from Lewis Research Center work is, by nature, most readily applicable to industrial products and processes, the Lewis Technology Utilization Office very actively supports applications of aerospace-related technology to medical and biological research, to public sector problems such as housing and transportation, and to ecological problems. Our evaluation of the new technology being developed here at Lewis considers not only the immediate potential applications, but, very importantly, the broad potential for application to socioeconomic problems, in keeping with our responsibility that the national investment in space and aeronautics return the maximum possible benefit to our country.

**Paul Foster**  
Technology Utilization Officer



able and, in cases where the item is patented, it is not exclusive for the first two years.

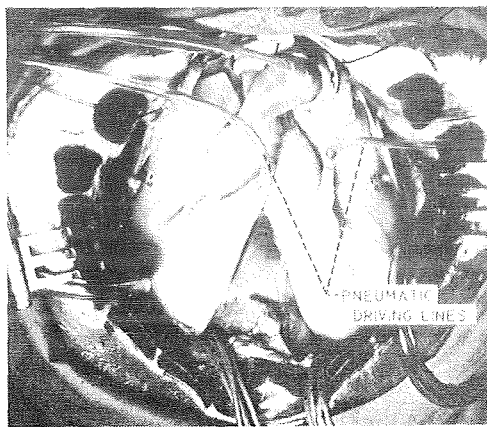
Some smaller companies complain that the library system needed to keep track of TU announcements is beyond their means.

Many industries do not have accurate data on what it costs to retrieve and evaluate data. For this reason, they can not establish the comparative costs of searching for information on their own, hiring an outside firm, or trying one of the TU offerings.

### Can It Be Improved?

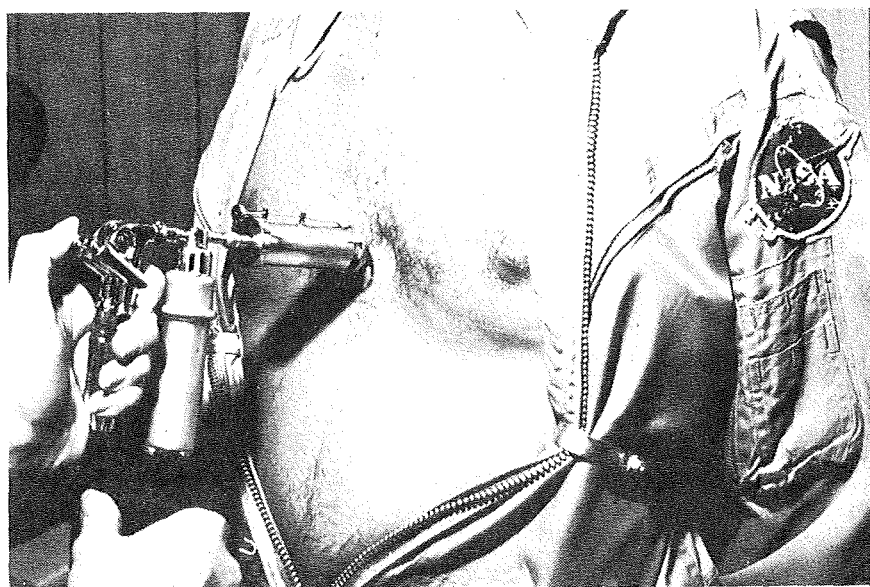
NASA's TU officials realize that a transfer of documents does not necessarily mean a transfer of information. So, one of the chief research efforts is to analyze in depth the methods by which information is acquired and disseminated by industry. With some knowledge of how this occurs, NASA can then modify its own programs to

*Continued on page 37*



Experimental plastic heart, shown here in the chest of a calf, is typical of the many biomedical applications of NASA research.

Spray-on electrode developed to instrument NASA pilots is now used in the study of muscle action.



## Used Computer Programs

■ COSMIC—the Computer Software Management and Information Center—helps organizations use knowledge that has resulted from many recent scientific and technical advances.

Founded at The University of Georgia in 1966, COSMIC provides, at reasonable cost, computer programs developed over periods of years by U. S. Government agencies and contractors. Originally, these programs cost millions of taxpayer dollars. Many of these programs can be incorporated into existing commercial or industrial operations with little or no modification. Available on tapes and cards, these programs save organizations money, when properly applied, without adding costly development time.

COSMIC may be thought of as a kind of clearinghouse in which computer software is transferred from government agencies to outside uses and as a transfer point between government agencies.

Before programs can be marketed to solve problems for business, industry, and other consumers, there are several steps through which a computer program must pass prior to receiving COSMIC's stamp of approval.

**Evaluation.** COSMIC engineers and scientists evaluate a program's documentation first. Evaluators look at

documentation from the standpoint of completeness for use by others and rate programs into one of four classes.

**Checking.** Programming personnel, well-versed in both documentation and programming, check the packages. Missing cards or subroutines are located, if possible.

**Corrections.** The same group either tries to correct any found errors or, if too difficult, contacts the program developer for assistance.

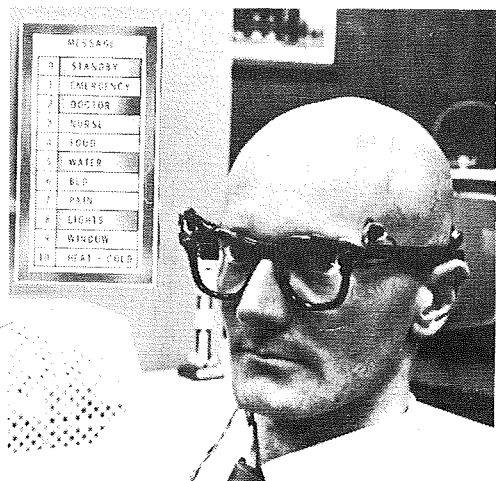
**Review.** The program analyst and the engineer conduct a final review of each program to decide whether it should be made available for consumer use.

**Publicity and Dissemination.** The evaluators write abstracts, or short descriptions, on all new programs, including such information as the program's function, language, method, machine requirements, number of program statements, and the program reference number. COSMIC also writes the NASA Tech Briefs, which are descriptions of programs sent to a NASA list of over 10,000 subscribers.

COSMIC also offers other customer services, such as searching for useful programs if a customer can define his needs. If a customer is less definite, COSMIC can send descriptions of programs in the customer's gen-



Instruments developed to monitor the condition of astronauts in space have been adapted to remotely monitor critically-ill hospital patients.



Paralyzed patient sends rudimentary code using on-off switch mounted on his glasses. Operation is based on sensors that detect eye movement.

eral area of interest. COSMIC also will help the customer to implement his programs. Research often is required and performed by COSMIC personnel when customers need help to convert programs from one machine language to another or to adapt a program for a different kind of machine. COSMIC also studies the feasibility of modifications on an individual basis. Sometimes, a program's documentation alone can aid a customer in design and development of his own softwares. COSMIC personnel also check thoroughly updates to prior programs and documentation and advise all users and previous customers of the availability of these updates.

COSMIC publishes a catalog, **Computer Programs Abstracts Journal**, in July with quarterly supplements, that may be ordered directly from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 at a cost of \$2.75 per year.

Those interested in COSMIC's Services can contact the center directly, or any of the six regional NASA dissemination centers, each of which have representatives familiar with what COSMIC has to offer.

**Paul Bidell**  
Associate Director COSMIC

## Regional Information

■ Western Research Application Center (WESRAC) is the NASA Technology Utilization Division's dissemination center for the far western states. Located at the University of Southern California, in Los Angeles, and administered by the Graduate School of Business Administration, WESRAC is one of the most recent RDC's established.

Like the other five regional facilities funded by NASA, WESRAC was a part of a program to broaden the use of new technology beyond the technical utilization activities in Washington and to make new technology conveniently available to that vital sector of the private economy which was not in defense or aerospace.

Three years after opening its doors, WESRAC was providing data search services for four hundred firms annually, ranging in size from Lockheed Corp. to the tiny Scientific Drilling Company of Newport, Calif., with less than 20 employees.

The variety and quality of the WESRAC's services are perhaps best expressed by quotes from clients. "We have access to the NASA tapes in Washington," says Horace Jacobs, an official at Lockheed, "but WESRAC's advantage is that they assign a person or two to work with a scientist. There's more personal contact."

A. Kendell Oulie, Director of WESRAC, explains, "What we're selling here at WESRAC is access—the use of computer and search capabilities." He adds, "We're not a grab-bag of treasures for next season's catalog. We can only tell if an idea is applicable, if it can be done within the realm of costs. The idea has to be in the client's head before he comes to us."

Still a different use of the data search facility comes from an official at Dart Industries, another WESRAC client. Here is a case of a large organization using the WESRAC facilities to search out the "state-of-the-art" of a company that Dart might be considering as an acquisition. "When we're probing new business areas for Dart, we need a quick reading to determine if a particular technology has consumer applications," said a member of Dart's technical planning group.

Still a third and different type of user is seen in a most recently acquired client, Pneumetrics, Inc. of Northridge, Calif. This company, seeking to gain a new business in the civilian sector of the economy, saw an opportunity in the development of a conversion kit to convert from gasoline to natural gas. It was a field in which they had no experience, neither in natural gas nor automotive combustion. Nor did they have the time or money to hire consultants to guide them. At WESRAC, Pneumetrics, Inc. was assigned a man holding a doctorate in Chemistry. Working with him, they framed their strategy for scanning the data tapes. The search yielded a collection of hard copy documents from which the new firm was able to complete its pilot model. One NASA document in particular is credited with alerting the firm. Declared Robert Sheldon, an officer of Pneumetrics, Inc., "I don't know what we'd have done without the help of NASA's WESRAC. Their work for us was fast, dead on center and highly reliable. I guess everyone involved in the project would say it was about the best thousand dollars we ever spent."

**George H. Corey**  
Western Research Application Center



## TECHNOLOGY UTILIZATION

make them more effective.

As more large conglomerate industries are formed, the bigger firms will have more extensive information retrieval systems and be better able to afford the TU programs.

By being more careful of what information is offered and by breaking down the information into basic ideas, NASA should be able to make the available data more attractive to industry.

Industry can help by improving its relationship with federal agencies. This will, hopefully, break down the prejudice against TU programs and make industry more aware of potential benefits.

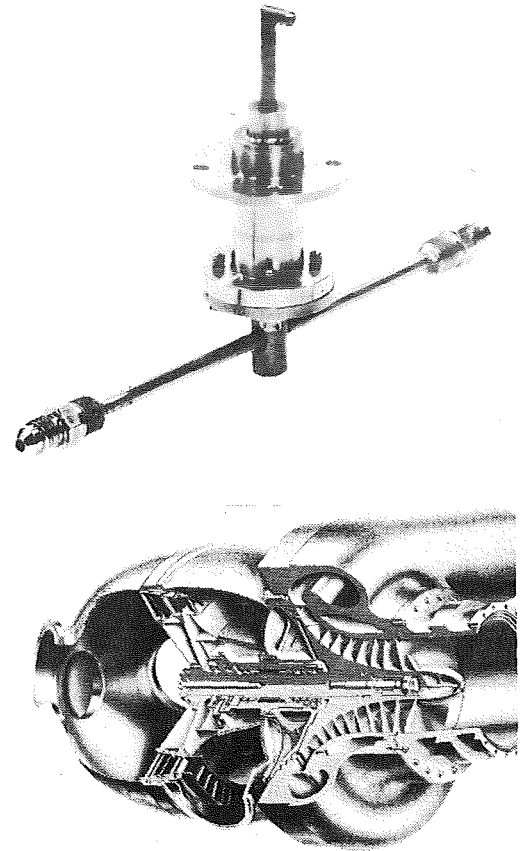
Since the main point of the TU program is the actual transfer of information, it has been suggested that there be more "information brokers." These are individuals, or firms, that specialize in monitoring the information government agencies make available. When they find a potentially useful product or idea, they attempt to market it

themselves or sell the developed idea to a company.

### Tried TU Lately?

Directors of the TU Program are making an earnest effort to improve the quality of the information they have available and to encourage industry's use of that information. Engineers and managers who have been discouraged in early dealings with TU programs, or who have totally ignored them, might do well to see what is now being offered.

The U. S. Government currently sponsors about two-thirds of all research done in the country. It also has a policy of making all nonclassified information available to industry. As more government agencies join NASA, the AEC, and a few others in systematic information dissemination programs, the government will become the nation's largest storehouse and supplier of technical data. That will be a source that no industry can afford to ignore.



Small transducer, top, measures gas pressure fluctuations of several thousand cycles per sec at temperatures up to 1000 F. Turbopump, above, moves liquid oxygen at a rate of 3,500 lb per sec and a head rise of 1,500 psi.

## "Technology Broker's" Opinion

■ When a manufacturer looks for any new product, it costs money, time, and effort. New product searches through NASA will eliminate some of all three.

No plan for product development or improvement has more than a slight chance of success unless backed by a solid statement of objectives and a willingness to do some research. By making this investment, the manufacturer can profit from the NASA Technology Utilization Program. Because NASA has documented its R & D activities, search of their results can eliminate or mitigate the risks and costs of exploration, screening, and, in many cases, prototype and manufacturing technology development. NASA people are frequently able to provide a comprehensive picture of the state-of-the-art, so that the value of prospective projects can be quickly understood. Or, a manufacturer can select an invention, technique, or technology from among those developments already completed by NASA that fits its operation. Once an idea is obtained from NASA's Technology Utilization files, the manufacturer can perform an analysis to determine the potential profitability of the product, technique, or technology. The NASA TU personnel and their university contractors operating the dissemination centers are most cooperative in trying to assist industry. What is fundamental in being able to use this service is to be able to define information sought in terms compatible with NASA's terminology.

Technology Transfer Corporation has had a series of meetings and contacts with NASA TU Program adminis-

trators, and every courtesy and facility has been readily available to our personnel. Our company has saved thousands of dollars by employing NASA published information and by talking with NASA personnel. With each successive contact, we learn a little more about what NASA can do for us and what it can do for industry in general. We have learned, for example, that university affiliated dissemination centers can assist with computerized data on specific technological disciplines. We have learned that Technology Utilization Officers are frequently well versed on the commercial possibilities of technologies and products reviewed by them. We have learned that patent counsel personnel are knowledgeable on the technical feasibility and on the proprietary position of products reviewed by them. We have learned that the NASA Technology Utilization Program is not specifically designed for us but for all industry in general, so that we must adjust our searching techniques to their system. We have not expected them to render a "personalized" service, but we have invested some of our time and effort to understand the NASA TU Program. We have received a profitable return on our investment. Based upon our experience, we believe that the industrial community can gain the true benefits from the space age.

E. Allen Stroup  
President  
Technology Transfer Corp.

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Cleveland, Ohio.

# NASA information is tapped for industry by this operational retrieval system

## WESRAC System

by David T. Komoto

**T**he Technology Utilization Program of the National Aeronautics and Space Administration is designed to disseminate information on new knowledge resulting from NASA aerospace activities to the business, scientific, and engineering communities; to other government agencies; and to interested public and private organizations. In 1962, NASA undertook a program to provide comprehensive bibliographic services covering the world's aerospace literature.

The NASA information bank is maintained by the NASA Scientific and Technical Information Facility at College Park, Maryland. The facility compiles report literature in a publication entitled *Scientific and Technical Aerospace Reports* (STAR). NASA also supports a publication put out by the American Institute of Aeronautics and Astronautics—the *International Aerospace Abstracts* (IAA). There is an arrangement between NASA and the AIAA by which the IAA is issued in coordination with STAR without overlap or duplication. IAA's worldwide coverage of scientific journals, books, and open meetings complements STAR's worldwide coverage of the report literature.

Following a policy of decentralization, NASA has made the data bank available on tapes to most NASA research centers, a number of major NASA contractors, and several university contractors participating in NASA's Technology Utilization Program. Update tapes are sent either on a biweekly or monthly basis, depending on necessity.

The University of Southern California and NASA have established WESRAC—Western Research Applica-

tion Center. WESRAC is a nonprofit organization funded by NASA. It coordinates the mass of technology contained in the NASA Information Bank with the needs of industry by using the resources of the university.

WESRAC maintains computer magnetic tapes, document abstracts, and reproductions of documents on microfiche. This material is updated monthly by the central NASA Scientific and Technical Information

	S	E	P	
B	0	1	1	SYNTHESIS=PO%1H
A	1	1	0	
8	0	0	0	SYNTHESIS
4	0	1	1	S0E=P
2	1	0	1	Y0S=O
1	0	1	1	N0I=%
				T0S=1
				H0=H

Table 1. Term Encoding Routine

Facility. All search and reporting operations are carried out independently by WESRAC at USC. WESRAC is organized to implement NASA's Technology Utilization Program in the West. Fig. 1 (p. 45) is a functional flow chart of the information system.

Computer operations at WESRAC's are oriented around magnetic tapes. WESRAC's current magnetic tapes contain summaries, called citations, of 500,000 items, which include scientific breakthroughs in fields of 34 subject categories ranging alphabetically from aerodynamics to thermodynamics. Computer tapes

# WESRAC System . . .

contain citations in chronological sequence, and the elements of a citation are composed of accession number, report number, availability, price, and key words. Title, author, and source are also given.

These citations are indexed by the key words (there is an average of 15 terms) which represent the major concepts of the document, enabling a computer to search through and pull out a citation if it pertains to a given topic.

**File organization.** The WESRAC tape file consists of a large number of paired blocks—a coded term block and an information block. Each information block is preceded by the coded term block (Fig. 2).

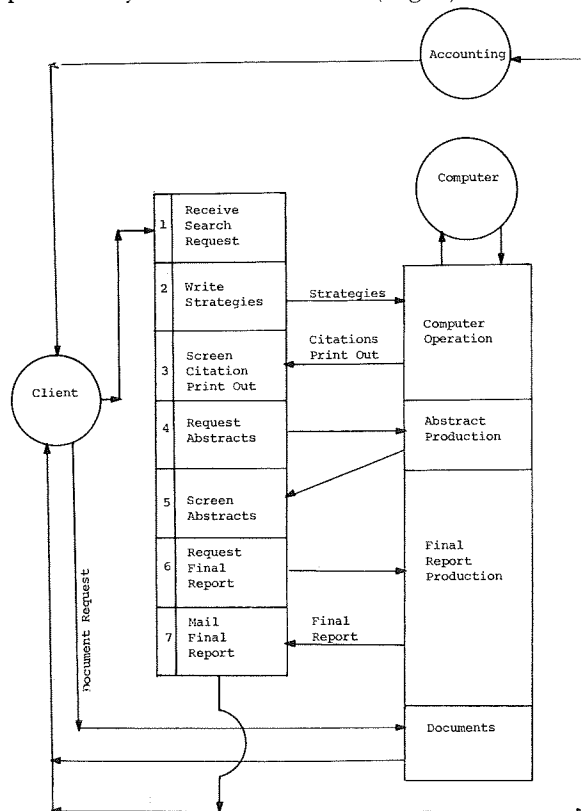


Fig. 1. Functional flow chart of the information system

The coded term block consists of five-character codes which correspond to indexing terms on a one-to-one basis. The method of encoding from variable-length alphabetic terms to five-character codes is described below. These codes represent a major improvement in search speed. Because of the difficulties in searching variable length data fields, it is advantageous to use a fixed length data segment when the comparison of two indexing terms is made.

The information block contains most of the conventional descriptive cataloging details—corporate source, title, author, report number, etc. It also contains the indexing terms assigned to a given document.

**Term encoding.** The technique used in the Term Encoding Routine involves reducing pairs of characters to a single character by combining the bits of the characters in the pairs in an Exclusive OR relationship to obtain the bits of a resultant character. As shown in Table 1 (p. 43), "S" Exclusive ORed with "E" gives "P."

A five-character code is generated from a variable length field by combining the first and every fifth character thereafter in the field to form the first character of the code, the second and every fifth character thereafter to form the second, and so on.

All subject term searches are made on these five characters rather than on the full, and often quite lengthy, alphabetic indexing terms. Considerable search time is saved with this technique.

Since the citations are indexed by coded terms, the search program compares question terms in the strategy against citation terms in the coded term block. At WESRAC, for example, the specialist, who is knowledgeable in the client's field of interest, maintains personal contact with the client and works with him to design the research logic (strategy). This strategy will be posed to the computer on punched cards that carry, in term reference, the search terms, weights of search terms, and logic to be followed by the computer.

The selection of appropriate indexing terms and the design of logical equations are major responsibilities of the WESRAC specialist, who must make the search broad enough to include all the items that would be of help to the client, and yet sufficiently

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1 KM2A1 3 1 KM2A1 2 3 L#ORA 3 1 L#ORA 2 3 OZ W 3 1 OZ W 3 1 Q L U 2 1 RC PX 3 3 RC PX 1 1 S.DGR 1 3 SP P 3 3 VE 1
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1GLASS FIBERS 1MATHEMATICAL MODELS 3MECHANICAL PROPERTIES 3METAL PLATES 3MODULUS OF ELASTICITY 1P
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ATES 1SHELL STABILITY 1STRESS ANALYSIS 1STRUCTURAL STRAIN $

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Fig. 2. NASA Tape WESRAC format (tape dump)

## WESRAC System . . .

narrow so that the client isn't overwhelmed with an unmanageable pile of hundreds of citations.

*Selection of indexing terms.* After the WESRAC spe-

Term Reference	Weight	Indexing Term	Posting Frequency
AA	20	CARBURETOR	16
A	19	ATOMIZATION	165
B	19	ATOMIZER	56
M	1	ANNULAR FLOW	164
N	1	ANNULAR JET	44
O	1	ANNULAR NOZZLE	50
P	1	COMBUSTION	6563
Q	1	FUEL	10783
R	1	INJECTION	3016

Minimum Weight = 20

Logical Equation =  $AA + (A+B) \cdot (M+N+O+P+Q+R)$

**Table 2. Sample Strategy**

cialist defines his client's problem, he develops a list of relevant search terms with their term references, weight, and posting frequencies. An example is given in the sample strategy.

*Logical equation and Polish notation.* In formulating a search strategy, the specialist may specify any desired relationship between indexing terms in the language of Boolean logic to construct search questions. Term references are used to formulate the logical equation (Table 2, above). The terms assigned to any one document must satisfy this relationship in order to be considered a "hit."

Polish notation is used internally in the search system to simplify evaluation of algebraic expressions used to specify search logic for terms. It is useful because it positionally establishes the priority of algebraic operations. This eliminates the use of parentheses and rules establishing priorities between operators.

Algebraically  $A.B+C$  is generally taken  $(A.B.)+C$ ; however, it could be taken as  $A.(B+C)$ . In Polish

notation,  $A.(B+C)$  is  $.+CBA$  and  $(A.B)+C$  is  $+C.BA$ . The logical equation shown previously will be taken as  $+.+++++RQPONM+BAA$ .

*Weight of terms.* Weight values may be arbitrarily assigned to each term in the search. The output of the search may be controlled by specifying that only items having a certain calculated weight, or greater, be retrieved. The weighting technique also permits a search which is simultaneously logical and combinatorial. In the sample equation  $AA+(A+B) \cdot (M+N+O+P+Q+R)$ , the weight value of 20 has been assigned to AA; 19 to A and B; 1 to M through R.

A logical "hit" should have a weight of 20. Weights are computed in advance of solving the logical equation. Items not meeting the required weight are rejected without further processing. However, weight alone is not sufficient to make an item a "hit"; a logical equation must be satisfied in order for weight to have any meaning.

The search program compares question terms in a strategy against citation terms. If the terms match, the routine to check the weight accumulator is set. If the citation satisfies the desired weight for a particular problem, then the equation is checked. If the equation is also satisfied, then a switch to retrieve the citation will be set.

## Basic computer search techniques

There are three basic searching techniques to compare the terms. They are the linear search method, the binary search method, and the collating search method.

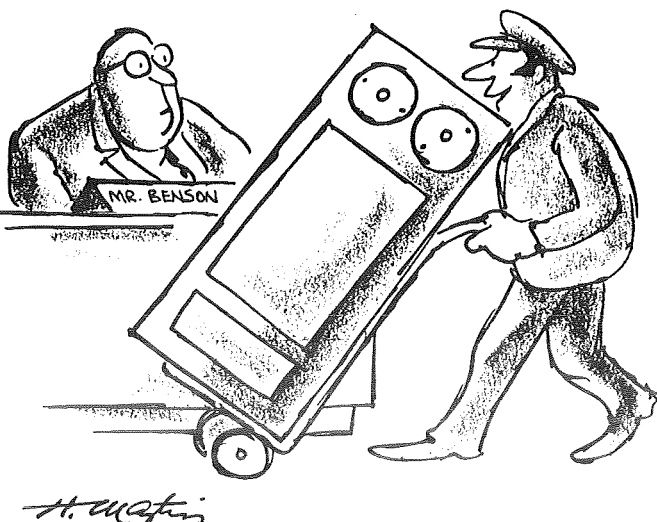
*Linear search method.* The linear search is one which begins at the first entry in the term table and scans through it, entry by entry, in sequence, until the desired entry is found. It has the advantage of being easy to program but many comparisons may be required. Fig. 3 shows the concept of the linear search method.

*Binary search method.* There are search techniques which reduce significantly the number of comparisons. One of them, the binary search technique is used in NASA search programs. This technique requires that the terms be arranged in some order (ascending or descending as in Table 3). The binary search is based on dividing the table in half, determining which half contains the term, dividing that part in half, and so on until a match is made, alter-

Sequence of Comparison	Number of Terms Left in Table	
1st	$\frac{N}{2}$	
2nd	$\frac{N}{2^2}$	
3rd	$\frac{N}{2^3}$	
.	.	
.	.	
.	.	
K	$\frac{N}{2^K}$	

K = Total Number of Comparisons (Maximum)  
 $K = AT \times \log_2 QT$

**Table 3. Binary Search Method**



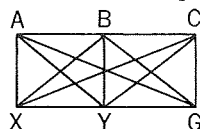
"En garde, Mr. Benson!"

nately decrementing and incrementing the address for the search.

**Collating search method.** This technique demands that the question terms and citation terms be arranged in some order (collating sequence). In the collating sequence search method, the total number of comparisons is equal to the sum of the question

Question Terms = QT

Assession Terms = AT



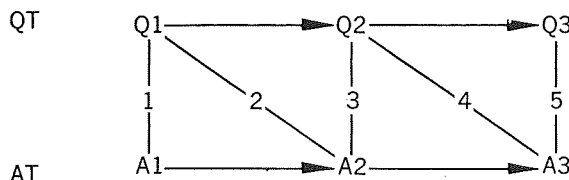
Total Number of Comparisons (Maximum) = QT x AT

**Fig. 3. Linear Search Method**

terms and the accession terms.  $K=QT=AT$  (maximum). An example in Fig. 4 shows the concept of the collating search technique.

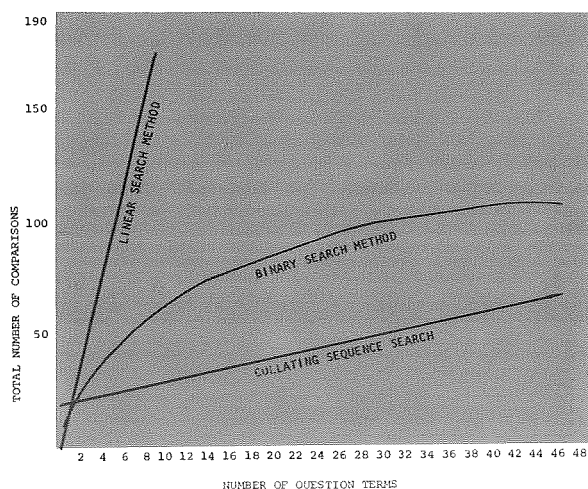
Sorted Question Terms  $Q1 < Q2 < Q3$   
Sorted Accession Terms  $A1 < A2 < A3$

As an example of typical search sequence, comparison will be executed as follows: Q1 compared against A1; if Q1 is greater than A1, AT address is advanced



**Fig. 4. Sequences of Comparisons for Collating Search Method**

to A2 to compare against Q1; if A2 is greater than Q1, QT address is advanced to Q2 to compare against A2; and so on. Keep modifying the address of QT table and AT table alternately until a match is found. If  $Q_{last}$  is less than A1, the search will be terminated and the system will be set to read the next coded term block.



**Fig. 5. Number of Total Comparisons by Search Method**

The comparative table and chart on Fig. 5 indicate the number of comparisons (maximum) required to complete the search logic by each searching method.

It appears that the collating search technique is the most suited to WESRAC operations in the present en-

vironment (the average number of accession terms in the coded term block is 55), even if the average number of terms is doubled.

However, it is evident that when the number of question terms is very low, the binary search is better

Number of QT	Number of AT	Linear Search Total Comparisons	Binary Search Total Comparisons	Collating Search Total Comparisons
20	2	40	20	22
20	4	80	40	24
20	8	160	60	28
20	16	320	80	36
20	32	640	100	52
20	64	1280	120	84
20	128	2360	140	148

than the collating search. We also see that when the number of accession terms is very large, the binary search is still better than the collating search.

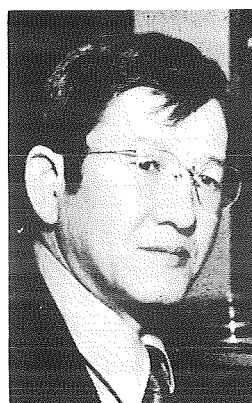
The NASA linear search system (binary search system) includes excellent strategy checking routines, extreme versatility in search capabilities, and almost complete freedom to specify type of printout. The system is completely documented but very slow.

The WESRAC search system was prepared to alleviate this problem and the result is a program that runs about 2.5 times as fast as the original NASA search system. Most of the increase in speed results from conversion from a binary search to a collating search. Typically, depending upon the number of terms to compare, a collating search employs fewer comparisons than the binary search.

## Conclusion

NASA, of course, is not the only organization maintaining computerized indexes to vast bodies of information. *Chemical Abstracts*, *Engineering Indexes*, *Textile Indexes*, *Department of Defense Files* and a few other data banks are already on computer tapes for researchers looking for information.

There is also a growing wave of information industry composed of small computer users, who may be able to apply data management concepts and search techniques similar to those used by the NASA Data Bank search system in their information retrieval. ■



Mr. Komoto is presently manager of Information Systems at the Western Research Application Center (WESRAC) in Los Angeles. He has a BA and an MA from Waseda University in Tokyo and an MBA in marketing from USC.



# Los Angeles T

## Computer Uncovers Japanese Cure for Mercury Pollution

BY GEORGE GETZE  
Times Science Writer

Three Japanese scientists have discovered a way of removing poisonous mercury compounds from waste water, according to the Western Research Application Center at USC.

Results of the Japanese research were published in Japan two years ago but had been unknown in the United States—even though mercury pollution of American lakes and streams is acknowledged to be a serious problem.

Kendell Oulie, director of WESRAC, said the finding and distribution of important but obscure scientific data—such as the Japanese research—is the function of the USC Center, a computerized information depot sponsored by the National Aeronautics and Space Administration.

### Computer Eases Task

Scientific information is accumulating so fast it is impossible for ordinary libraries to keep up with it. In fact, without the computer, the finding of data being published in scientific journals throughout the world is often as difficult a job as the original research.

For example, the Japanese research in the removal of mercurial compounds was not noted until WESRAC made a computer search of all data published anywhere having anything to do with mercury, Oulie said.

"More than half a million documents were searched," he said.

## MERCURY THREAT

"It took two hours to run through all the taped references."

The Japanese biochemists who described a biological method of ridding waste water of organic compounds of mercury are Tomoo Suzuki, Kensuke Furukawa, and Kenzo Tonomura, all of the Fermentation Research Institute at Inage, Japan.

They described the method in the December, 1968, issue of the Japanese language journal, "Fermentation Technology."

Dr. Bruno Loran, a chemist at WESRAC, said the organic compounds of mercury are even more dangerous and poisonous than the element mercury, itself.

"Mercury and its inorganic salts can be easily removed from solutions," Loran said.

"The organic compounds of mercury, however, are a different story. They not only are harder to remove and identify, they also are absorbed by algae in water and thus become part of the basic food chain when eaten by fish," he said.

The Japanese researchers found that a strain of bacteria, *Pseudomonas* K-62, not only was not killed by mercurial compounds, but actually thrived on them.

In laboratory experiments, 90% of the compounds in solution was removed by the bacteria within 30 minutes, they reported in *Fermentation Technology*.

Loran said the bacteria take up the mercury compounds. They are then placed in nutrient cultures, where they promptly release the toxic compounds in the form of a volatile gas. The gas can then be easily trapped by a carbon filter and made innocuous.

"One of the interesting things about it is that the bacteria can be reused many times and perform the same function over and over again," Loran said.

Use of the Japanese research in the cleaning up of American and Canadian streams and lakes would require each industrial polluter to maintain a closed system in which the *Pseudomonas* bacteria would break up the complicated mercurial enzyme chains in a series of ponds and sluices.

The two most serious mercury polluters are the processors of seeds that are coated with antifungicides with a mercury base, and the paper manufacturers who use mercury compounds to inhibit slime.

"The delta of the Sacramento River already is approaching a quarantine basis on account of mercury pollution," Oulie said.

He said technology is the only way of overcoming the many pollution problems and that computer recovery systems such as WESRAC are playing an increasingly important role in bringing technology to bear.

## Student Disciplinary System Toughened by State Colleges

Traditional campus panels to hear charges of misconduct against students have been abolished by the California State Colleges as part of a major overhaul of student discipline.

which a student must be charged, the hearing conducted and a decision handed down.

Penalties are unchanged from the past: expulsion, suspension, probation.

Now the state's instruction is

## APPENDIX C

1. Issued Abstracts Relative to Microfiche or Hard Copy Documents
2. Hard Copy Issued by STAR and IAA Category
3. Microfiche Issued by STAR and IAA Category
4. RDC Marketing/Service Contacts (Clients)
5. RDC Marketing Approaches (Non-Clients)
6. RDC Large and Small Business Contract Clients
7. RDC Annual Contract Clients by SIC Code
8. RDC Large and Small Business Special Clients
9. RDC Special Clients by SIC Code

# APPENDIX C1

## ISSUED ABSTRACTS RELATIVE TO MICROFICHE OR HARD COPY DOCUMENTS

(By contract quarters beginning 1 Feb. 1969)

	ABSTRACTS and CITATIONS	DOCUMENTS
1st Q 1969	2,703	538
2nd Q 1969	2,840	327
3rd Q 1969	3,313	574
4th Q 1969	2,260	445
Total 1969	11,116	1,884
1st Q 1970	2,225	427
2nd Q 1970	4,485	445
3rd Q 1970	3,139	844
4th Q 1970		
Total 1970		

APPENDIX C2  
HARD COPY ISSUED BY STAR AND IAA CATEGORY

(By contract quarters beginning 1 Feb. 1969)

Cate- gory	1st Q 1969	2nd Q 1969	3rd Q 1969	4th Q 1969	Total 1969	1st Q 1970	2nd Q 1970	3rd Q 1970	4th Q 1970	Total 1970
1	5	6	5	3	19	8	2	10		
2	4	3	15	19	41	21	3	31		
3	9	4	8	2	23	3	4	21		
4	7	3	8	10	28	18	6	2		
5	6	6	9	5	26	19	7	9		
6	10	12	10	10	42	17	7	18		
7	40	22	16	4	82	13	6	8		
8	39	17	31	10	97	11	9	11		
9	91	24	39	24	178	52	22	27		
10	16	15	7	4	42	2	3	0		
11	6	4	16	1	27	8	3	11		
12	3	0	8	1	12	5	1	6		
13	3	11	14	21	49	31	10	25		
14	32	22	17	50	121	47	14	14		
15	49	26	49	31	155	38	18	53		
16	12	0	15	3	30	5	1	2		
17	25	12	47	25	109	19	14	30		
18	15	17	25	19	76	17	14	14		
19	10	4	7	7	28	7	6	5		
20	7	5	11	7	30	10	10	12		
21	7	6	7	9	29	1	5	2		
22	0	0	7	3	10	2	3	3		
23	3	1	3	1	8	11	2	4		
24	1	4	5	2	12	2	2	16		
25	2	3	6	2	13	3	2	14		
26	35	3	1	12	51	14	9	22		
27	4	1	1	0	6	2	6	6		
28	3	3	6	1	13	8	2	9		
29	1	0	3	0	4	2	0	1		
30	3	4	9	11	27	7	6	11		
31	4	5	22	2	33	8	4	4		
32	34	17	61	18	130	20	19	14		
33	3	1	9	4	17	5	3	21		
34	17	10	15	5	48	3	5	5		
Other	32	56	36	22	136	64	101	394		
Total	538	327	548	349	1762	396	416	836		

# APPENDIX C3

## MICROFICHE ISSUED BY STAR AND IAA CATEGORY

(Bycontract quarters beginning 1 Feb. 1969)

Cato- gory	1st Q 1969	2nd Q 1969	3rd Q 1969	4th Q 1969	Total 1969	1st Q 1970	2nd Q 1970	3rd Q 1970	4th Q 1970	Total 1970
1			8	3	11	0	0	0		
2			4	32	36	1	0	0		
3			1	1	2	0	0	0		
4		NONE	0	3	3	1	1	0		
5			0	0	0	1	0	1		
6		ISSUED	0	5	5	2	1	0		
7			1	0	1	1	0	0		
8			0	3	3	0	1	0		
9			0	1	1	0	0	0		
10			0	0	0	0	0	0		
11			0	2	2	0	1	0		
12		NONE	2	2	4	0	0	0		
13			0	3	3	4	0	4		
14			0	19	19	6	0	1		
15		ISSUED	0	1	1	4	0	0		
16			0	0	0	0	0	0		
17			0	2	2	0	0	0		
18			0	2	2	0	1	0		
19			0	0	0	0	0	0		
20			1	2	3	3	0	0		
21			0	0	0	0	1	0		
22			0	1	1	0	0	0		
23		NONE	0	1	1	0	2	0		
24			0	1	1	0	14	0		
25			0	1	1	0	0	0		
26		ISSUED	0	0	0	0	1	0		
27			0	0	0	0	1	0		
28			0	3	3	0	1	0		
29			0	0	0	0	1	0		
30			0	0	0	0	0	0		
31			1	0	1	1	1	0		
32			8	6	14	2	1	1		
33			0	1	1	3	0	1		
34			0	1	1	1	1	0		
Other			0	0	0	1	0	0		
			26	64	190	21	29	8		

# APPENDIX C4

## RDC MARKETING/SERVICE CONTACT (With Clients)

(By contract quarters beginning 1 Feb. 1969)

Type Contact	TECHNICAL (Applications Engineers)		MARKETING	
	Tele- phone	Visit	Tele- phone	Visit
1st Q 1969	91	41	86	41
2nd Q 1969	85	32	73	65
3rd Q 1969	90	40	83	63
4th Q 1969	81	30	68	37
Total 1969	347	143	310	206
1st Q 1970	120	40	46	27
2nd Q 1970	125	33	82	48
3rd Q 1970	130	25	107	60
4th Q 1970				
Total 1970				



# APPENDIX C5

## RDC MARKETING APPROACHES (Non-Clients)

(By contract quarters beginning 1 Feb. 1969)

TYPE	Direct Mail	Telephone Contact	Personal Presentations	Group Presentations	Ads (Paid)	Ads (Not Paid)	Journal/Magazine Articles
1st Q 1969	0	600	220	5	2	**	1
2nd Q 1969	0	713	380	0	1	***	2
3rd Q 1969	1,461	442	337	2	2	**	8
4th Q 1969	7,300	226	178	12	0	**	6
Total 1969	8,761	1,981	1,115	19	5	**	17
1st Q 1970	25,824	319	89	5	0	**	2
2nd Q 1970	20,312	514	183	3	0	**	8
3rd Q 1970	30,474	434	244	4	0	**	3
4th Q 1970							
Total 1970							

# APPENDIX C6

## RDC Large and Small Business Contract Clients (Cumulative)

(By contract quarters beginning 1 Feb. 1969)

Small = under 500 employees

CLIENT SIZE	LARGE	SMALL
1st Q 1969	22	31
2nd Q 1969	24	33
3rd Q 1969	23	33
4th Q 1969	19	34
1st Q 1970	15	24
2nd Q 1970	16	37
3rd Q 1970	18	40
4th Q 1970		



# APPENDIX C7

## RDG ANNUAL CONTRACT CLIENTS BY SIC CODE (Cumulative)

(By contract quarters beginning 1 Feb. 1969)

(Continued on next page)

SIC Code	1st Q 1969	2nd Q 1969	3rd Q 1969	4th Q 1969	1st Q 1970	2nd Q 1970	3rd Q 1970	4th Q 1970
1551	0	0	0	0	0	0	0	
1921	1	1	1	1	1	1	1	
1999	1	1	1	1	1	1	1	
2641	0	0	0	0	0	0	0	
2811	1	0	0	0	0	0	0	
2812	1	1	1	1	0	0	0	
2816	1	1	1	1	1	1	1	
2819	1	1	1	0	0	0	0	
2831	0	0	0	0	0	1	1	
2899	0	0	0	0	0	0	1	
2992	1	1	0	0	0	0	0	
2999	0	0	0	0	0	1	1	
3011	1	1	1	1	1	1	1	
3079	2	0	0	0	0	0	0	
3241	1	1	1	1	1	1	1	
3272	1	1	1	1	0	0	0	
3334	0	1	1	1	1	0	0	
3341	1	1	1	1	0	0	0	
3349	0	1	0	0	0	0	0	
3356	1	1	1	1	0	0	0	
3360	1	1	1	1	0	1	1	
3433	1	1	1	1	0	0	0	
3449	1	0	1	1	0	0	0	
3452	0	0	0	0	0	0	0	
3494	1	1	1	1	2	2	2	
3499	0	0	0	0	1	1	1	
3500	1	1	1	0	0	0	0	
3533	0	0	0	0	0	0	0	
3553	1	0	0	0	0	0	0	
3559	0	1	1	1	2	2	2	
3571	2	3	3	2	2	2	2	
3599	0	0	0	1	0	0	1	
3610	0	0	0	0	0	1	1	

RDG ANNUAL CONTRACT CLIENTS BY SIC CODE  
(Cumulative)

(By contract quarters beginning 1 Feb. 1969)

SIC Code #	1st Q 1969	2nd Q 1969	3rd Q 1969	4th Q 1969	1st Q 1970	2nd Q 1970	3rd Q 1970	4th Q 1970
3611	1	2	2	2	2	0	0	
3621	0	0	0	0	0	0	0	
3639	0	0	0	0	0	1	1	
3641	1	1	0	0	0	0	0	
3643	1	1	0	0	0	0	0	
3651	1	1	1	0	0	0	0	
3661	1	1	1	1	0	0	0	
3662	4	6	6	6	5	4	4	
3672	0	0	0	0	0	1	1	
3679	4	4	3	3	2	3	3	
3690	1	0	0	0	0	0	0	
3694	0	0	0	0	0	0	0	
3699	1	1	2	1	1	1	1	
3714	0	0	0	1	1	1	1	
3720	1	1	1	1	1	1	1	
3721	1	1	1	1	1	0	0	
3722	1	1	1	1	1	1	2	
3729	2	2	2	2	2	2	2	
3811	2	2	3	3	1	2	2	
3821	1	1	1	1	0	0	0	
3831	0	2	2	2	2	2	2	
3841	1	1	1	1	0	1	2	
4833	0	0	0	0	0	1	1	
4924	1	1	1	0	0	0	1	
5091	0	0	0	0	0	0	1	
5912	0	0	1	1	1	1	1	
7391	2	2	2	2	0	4	3	
7392	0	0	0	0	0	0	0	
7821	1	1	1	1	1	2	2	
8911	1	1	2	2	2	6	6	
8921	2	2	2	3	2	2	2	
9100	1	1	1	1	1	1	1	
Mil.	0	0	0	0	0	0	0	
Bio. Med	0	0	0	0	0	0	0	
Total	53	57	56	53	39	53	58	

APPENDIX C8

RDC Large and Small Business Special Clients  
*(individual search buyers)*  
(Cumulative)

(By contract quarters beginning 1 Feb. 1970)

Small = under 500 employees

CLIENT SIZE	LARGE	SMALL
1st Q 1970	3	26
2nd Q 1970	8	36
3rd Q 1970	9	45
4th Q 1970		

## APPENDIX C9

RDC SPECIAL CLIENTS BY SIC CODE  
(Individual Search Buyer)(By contract quarters beginning 1 Feb. 1970)  
(Continued on next page)

SIC Code #	1st Q 1970	2nd Q 1970	3rd Q 1970	4th Q 1970
2099	1	0	0	
2999	1	0	0	
2834	0	1	0	
2840	0	1	0	
2843	2	0	1	
2873	1	0	0	
2899	1	0	0	
2911	1	0	0	
2999	0	1	0	
3069	1	0	0	
3295	1	0	0	
3511	0	2	0	
3531	0	1	0	
3532	1	0	1	
3560	2	0	0	
3599	1	0	0	
3629	1	0	1	
3660	2	0	2	
3662	1	1	0	
3671	1	0	0	
3672	1	0	0	
3679	1	0	0	
3714	0	1	0	

## APPENDIX C9.

Page 2

## RDC SPECIAL CLIENTS BY SIC CODE

(Individual Search Buyer)

(By contract quarters beginning 1 Feb. 1970)

SIC Code #	1st Q 1970	2nd Q 1970	3rd Q 1970	4th Q 1970
3721	0	1	0	
3722	0	1	0	
3729	0	1	2	
3799	0	1	0	
3811	3	0	0	
3831	1	0	1	
3861	1	0	1	
3941	1	0	0	
3999	0	1	0	
4511	0	1	0	
7391	0	1	0	
Bio. Med.	2	1	1	
Quarter Total	29	15	10	
Cumulative Total	29	44	54	